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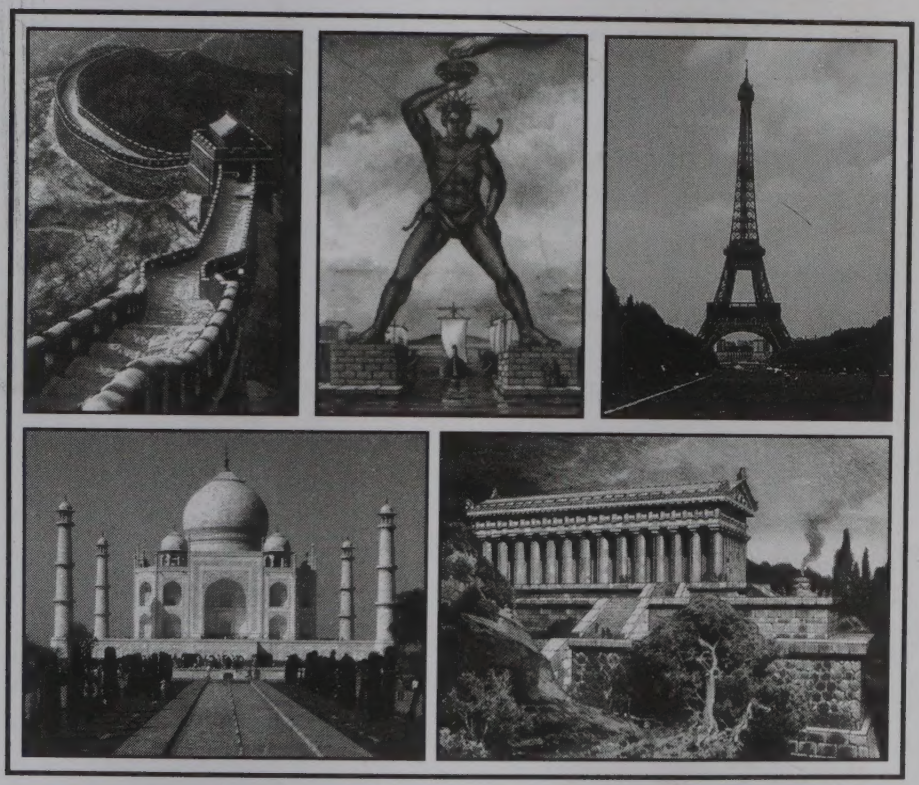

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Preface

Earth is a very beautiful planet. It has a store of treasures that can never be exhausted. The treasures of Earth are precious like gold and diamonds, but more precious than these are the treasures that fill a man with amazement, wonder, surprise and joy. The wonders of the Earth are many and are of many kinds. Some of them are natural– nature formed them over time in a way that is beyond understanding.

Geothermal phenomena, like deep sea vents, volcanoes and waterfalls of breathtaking beauty, images of oneself haloed by rainbows formed high in the sky, take one's breathaway. One can look and wonder at the marvels of the nature.

Some of the wonders are architectural marvels, account for the brilliance of the human mind, its perceptive power and adroit endeavours, which were considered as some of the greatest wonders of the world, but not great enough to leave behind an indelible impression on humanity's mind, and lost to the other greater and stupendous works of the human imagination. The momentous works of art and architecture by the humans and their ability to capture in realistic frame baffled travellers and onlookers from times immemorial and with the advance of the science and technology, engineering skills and construction facilities, the human hands began to carve out of their minds, edifices which made the world pleasanter and beautiful.

This book aims to present before the reader, 'a few' of the countless wonders our planet has to offer us.

–Publishers

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Mummy at Vatican

A Mummy is a corpse whose skin and organs have been preserved by either intentional or incidental exposure to chemicals, extreme coldness, very low humidity, or lack of air when bodies are submerged in bogs. Presently, the oldest discovered (naturally) mummified human corpse was a decapitated head dated as 6,000 years old and was found in 1936.

The Seven Wonders of the Ancient World

The ancient Greeks loved to compile lists of the marvellous structures in their world. Though we think of the Seven Wonders of the Ancient World as a single list today, there were actually a number of lists compiled by different Greek writers. Antipater of Sidon, and Philon of Byzantium, drew up two of the most well-known lists. Many of the lists agreed on six of the seven items.

The final place on some lists was awarded to the Walls of the City of Babylon. On others, the Palace of Cyrus, king of Persia took the seventh position. Finally, toward the 6th century A.D., the final item became the Lighthouse at Alexandria. Since then it was Greeks who made the lists it is not unusual that many of the items on them were examples of Greek culture.

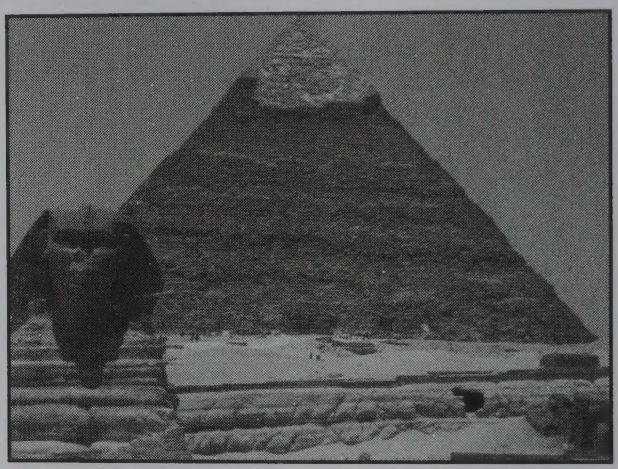
The writers might have listed the Great Wall of China if then had known about it, or Stonehenge if they'd seen it, but these places were beyond the limits of their world. It is a surprise to most people to learn that not all the Seven Wonders existed at the same time. Even if you lived in ancient times you would have still needed a time machine to see all seven.

While the Great Pyramids of Egypt was built centuries before the rest and is still around today (it is the only 'wonder' still intact) most of the others only survived a few hundred years or less. The Colossus of Rhodes stood only a little more than half a century before an earthquake toppled it.

1

Khufu's Great Pyramid

It's 756 feet long on each side, 450 feet high and is composed of 2,300,000 blocks of stone, each averaging 2½ tons in weight. Despite the makers' limited surveying tools no side is more than 8 inches different in length than another, and the whole structure is perfectly oriented to the points of the compass. Until the 19th century it was the tallest structure in the world and, at the age of 4,500 years, it is the only one of the famous 'Seven Wonders of the Ancient World' that still stands. It is the Great Pyramid of Khufu, at Giza, Egypt.



Some of the earliest history of the Pyramid comes from a Greek traveller named Herodotus of Halicanassus. He visited Egypt around 450 BC and included a description of the Great Pyramid in a history book he wrote. Herodotus was told by his Egyptian guides that it took twenty-years for a force of 100,000 oppressed slaves to build the pyramid. Stones were lifted into position by the use of heavy machines. The purpose of the structure, according to Herodotus' sources, was as a tomb for the Pharaoh Khufu (whom the Greeks referred to as Cheops).

Most of what Herodotus tells us is probably false.

Scientists calculate that fewer men and less years were needed than Herodotus suggests. It also seems unlikely that slaves or complicated machines were needed for the pyramid construction. It isn't surprising that the Greek historian got it wrong. By the time he visited the site the great pyramid was already 20 centuries old, and much of the truth about it was shrouded in the mists of history.

Certainly the idea that it was a tomb for a Pharaoh, though, seems in line with Egyptian practices. For many centuries before and after the construction of the Great Pyramid the Egyptians had interned their dead Pharaoh-Kings, whom they believed to be living Gods, in intricate tombs. Some were above ground structures, like the pyramid, others were cut in the rock below mountains. All the dead leaders, though, were outfitted with the many things, it was believed they would need in the after-life to come. Many were buried with untold treasures.

Even in ancient times thieves, breaking into the sacred burial places, were a major problem and Egyptian architects became adept at designing passageways that could be plugged with impassable granite blocks, creating secret, hidden rooms and making decoy chambers. No matter how clever the designers became, though, robbers seemed to be smarter and with almost no exceptions each of the great tombs of the Egyptian Kings were plundered.

In 820 A.D. the Arab Caliph Abdullah Al Manum decided to search for the treasure of Khufu. He gathered a gang of workmen and, unable to find the location of a reputed secret door, started burrowing into the side of the monument. After a hundred feet of hard going they were about to give up when they heard a heavy sound echo through the interior of the pyramid. Digging in the direction of the sound they soon came upon a passageway that descended into the heart of the structure. On the floor lay a large block that had fallen from the ceiling, apparently causing the noise they had heard. Back at the beginning of the corridor they found the secret hinged door to the outside they had missed.

Working their way down the passage they soon found themselves deep in the natural stone below the pyramid. The corridor stopped descending and went horizontal for about 50 feet, then ended in a blank wall. A pit extended downward from there for about 30 feet, but it was empty.

When the workmen examined the fallen block they noticed a large granite plug above it. Cutting through the softer stone around it they found another passageway that extended up into the heart of the pyramid. As they followed this corridor upward they found several more granite blocks closing off the tunnel. In each case they cut around them by burrowing through the softer limestone of the walls. Finally they found themselves in a low, horizontal passage that lead to a small, square, empty room. This became known as the 'Queen's Chamber,' though it seems unlikely that it ever served that function.

Back at the junction of the ascending and descending passageways, the workers noticed an open space in the ceiling. Climbing up they found themselves in a high-roofed, ascending passageway. This became known as the 'Grand Gallery.' At the top of the gallery was a low horizontal passage that led to a large room, some 34 feet long, 17 feet wide, and 19 feet high, the 'King's Chamber.' In the centre was a huge granite sarcophagus without a lid. Otherwise the room was completely empty.

The Arabs, as if in revenge for the missing treasure, stripped the pyramid of its fine white limestone casing and used it for building in Cairo. They even attempted to disassemble the great pyramid itself, but after removing the top 30 feet of stone, they gave up on this impossible task.

So what happened to the treasure of King Khufu? Conventional wisdom says that, like so many other royal tombs, the pyramid was the victim of robbers in ancient times. If we believe the accounts of Manum's men, though, the granite plugs that blocked the passageways were still in place when they entered the tomb. How did the thieves get in and out?

In 1638 a English mathematician, John Greaves, visited the pyramid. He discovered a narrow shaft, hidden in the wall, that connected the Grand Gallery with the descending passage. Both ends were tightly sealed and the bottom was blocked with debris. Some archaeologists suggested this route was used by the last of the Pharaoh's men to exit the tomb, after the granite plugs had been put in place, and by the thieves to get inside. Given the small size of the passageway and the amount of debris it seems unlikely that the massive amount of treasure, including the huge missing sarcophagus lid, could have been removed this way.

Some have suggested that the pyramid was never meant as a tomb, but as an astronomical observatory. The Roman author Proclus, in fact, states that before the pyramid was completed it did serve in this function. We can't put two much weight on Proclus words, though, remembering that when he advanced his theory the pyramid was already over 2000 years old.

Richard Proctor, an astronomer, did observe that the descending passage could have been used to observe the transits of certain stars. He also suggested that the grand gallery, when open at the top, during construction, could have been used for mapping the sky.

Many strange, and some silly, theories have arisen over the years to explain the pyramid and it's passageways. Most archaeologists, though, accept the theory that the great pyramid was just the largest of a tradition of tombs used for the Pharaohs of Egypt.

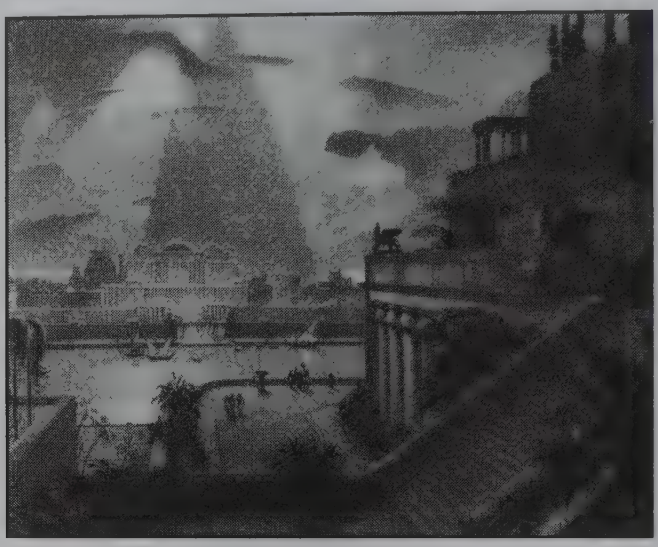
Nobody knows what happened to Khufu's mummy and treasure? Extensive explorations have found no other chambers or passageways. Still one must wonder if, perhaps in this one case, the King and his architects outsmarted both the ancient thieves and modern archaeologists and that somewhere in, or below, the last wonder of the ancient world, rests Khufu and his sacred gold.

❐

2

The Hanging Gardens of Babylon

The ancient city of Babylon, under King Nebuchadnezzar II, must have been a wonder to the traveller's eyes. "In addition to its size," wrote Herodotus, a historian in 450 BC, "Babylon surpasses in splendor any city in the known world."



Herodotus claimed the outer walls were 56 miles in length, 80 feet thick and 320 feet high. Wide enough, he said, to allow a four-horse chariot to turn. The inner walls were "not so thick as the first, but hardly less strong." Inside the walls were fortresses and temples containing immense statues of solid gold. Rising above the city was the famous Tower of Babel, a temple to the god Marduk, that seemed to reach to the heavens.

While archaeological examination has disputed some of Herodotus's claims (the outer walls seem to be only 10 miles long and not nearly as high) his narrative does give us a sense of how awesome the features of the city appeared to those that visited it. Interestingly enough, though, one of the city's most spectacular sites is not even mentioned by Herodotus:

The Hanging Gardens of Babylon, one of the Seven Wonders of the Ancient World.

Accounts indicate that the garden was built by King Nebuchadnezzar, who ruled the city for 43 years starting in 605 BC (There is a less-reliable, alternative story that the gardens were built by the Assyrian Queen Semiramis during her five year reign starting in 810 BC). This was the height of the city's power and influence and King Nebuchadnezzar constructed an astonishing array of temples, streets, palaces and walls.

According to accounts, the gardens were built to cheer up Nebuchadnezzar's homesick wife, Amyitis. Amyitis, daughter of the king of the Medes, was married to Nebuchadnezzar to create an alliance between the nations. The land she came from, though, was green, rugged and mountainous, and she found the flat, sun-baked terrain of Mesopotamia depressing. The king decided to recreate her homeland by building an artificial mountain with rooftop gardens.

The Hanging Gardens probably did not really 'hang' in the sense of being suspended from cables or ropes. The name comes from an inexact translation of the Greek word *kremastos* or the Latin word *pensilis*, which mean not just 'hanging', but 'overhanging' as in the case of a terrace or balcony.

The Greek geographer Strabo, who described the gardens in first century BC, wrote, "It consists of vaulted terraces raised one above another, and resting upon cube-shaped pillars. These are hollow and filled with earth to allow trees of the largest size to be planted. The pillars, the vaults, and terraces are constructed of baked brick and asphalt.

"The ascent to the highest story is by stairs, and at their side are water engines, by means of which persons, appointed expressly for the purpose, are continually employed in raising water from the Euphrates into the garden."

Strabo touches on what, to the ancients, was probably the

most amazing part of the garden. Babylon rarely received rain and for the garden to survive it would have had to been irrigated by using water from the nearby Euphrates River. That meant lifting the water far into the air so it could flow down through the terraces, watering the plants at each level. This was probably done by means of a 'chain pump.'

A chain pump is two large wheels, one above the other, connected by a chain. On the chain are hung buckets. Below the bottom wheel is a pool with the water source. As the wheel is turned, the buckets dip into the pool and pick up water. The chain then lifts them to the upper wheel, where the buckets are tipped and dumped into an upper pool. The chain then carries the empty ones back down to be refilled.

The pool at the top of the gardens could then be released by gates into channels which acted as artificial streams to water the gardens. The pump wheel below was attached to a shaft and a handle. By turning the handle slaves provided the power to run the contraption.

Construction of the garden wasn't only complicated by getting the water up to the top, but also by having to avoid having the liquid ruin the foundation once it was released. Since stone was difficult to get on the Mesopotamian plain, most of the architecture in Babel utilized brick. The bricks were composed of clay mixed with chopped straw and baked in the sun. The bricks were then joined with bitumen, a slimy substance, which acted as a mortar. These bricks quickly dissolved when soaked with water. For most buildings in Babel this wasn't a problem because rain was so rare. However, the gardens were continually exposed to irrigation and the foundation had to be protected.

Diodorus Siculus, a Greek historian, stated that the platforms on which the garden stood consisted of huge slabs of stone (otherwise unheard of in Babel), covered with layers of reed, asphalt and tiles. Over this was put "a covering with sheets of lead, that the wet which drenched through the

earth might not rot the foundation. Upon all these was laid earth of a convenient depth, sufficient for the growth of the greatest trees. When the soil was laid even and smooth, it was planted with all sorts of trees, which both for greatness and beauty might delight the spectators."

How big were the gardens? Diodorus tells us it was about 400 feet wide by 400 feet long and more than 80 feet high. Other accounts indicate the height was equal to the outer city walls. Walls that Herodotus said were 320 feet high.

In any case the gardens were an amazing sight: A green, leafy, artificial mountain rising off the plain. But did it actually exist? After all, Herodotus never mentions it.

This was one of the questions that occurred to German archaeologist Robert Koldewey in 1899. For centuries before that the ancient city of Babel was nothing but a mound of muddy debris. Though unlike many ancient locations, the city's position was well-known, nothing visible remained of its architecture. Koldewey dug on the Babel site for some fourteen years and unearthed many of its features including the outer walls, inner walls, foundation of the Tower of Babel, Nebuchadnezzar's palaces and the wide processional roadway which passed through the heart of the city.

While excavating the Southern Citadel, Koldewey discovered a basement with fourteen large rooms with stone arch ceilings. Ancient records indicated that only two locations in the city had made use of stone, the north wall of the Northern Citadel, and the Hanging Gardens. The north wall of the Northern Citadel had already been found and had, indeed, contained stone. This made it seem likely that Koldewey had found the cellar of the gardens.

He continued exploring the area and discovered many of the features reported by Diodorus. Finally a room was unearthed with three large, strange holes in the floor. Koldewey concluded this had been the location of the chain pumps that raised the water to the garden's roof.

The foundations that Koldewey discovered measured

some 100 by 150 feet. Smaller than the measurements described by ancient historians, but still impressive.

While Koldewey was convinced he'd found the gardens, some modern archaeologists call his discovery into question arguing that this location is too far from the river to have be irrigated with the amount of water that would have been required. Also tablets recently found at the site suggest that the location was used for administrative and/or storage purposes, not as a pleasure garden.

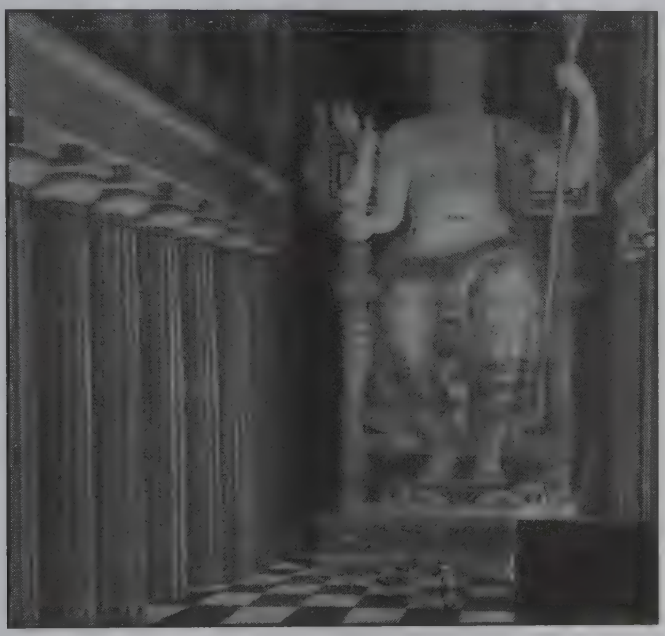
Wherever the location of the gardens were, we can only wonder if Queen Amyitis was happy with her fantastic present, or if she continued to pine for the green mountains of her homeland.

❐

3

The Statue of Zeus at Olympia

In ancient times the Greeks held one of their most important festivals, The Olympic Games, in honour of the King of their gods, Zeus. Like modern Olympics, athletes travelled from distant lands, including Asia Minor, Syria, Egypt and Sicily, to compete in the games. The Olympics were first started in 776 B.C. and held at a shrine to Zeus located on the western coast of Greece in a region called



Peloponnesus. The games, held every four years, helped to unify the Greek city-states. Sacred truce was declared during the games and wars were stopped. Safe passage was given to all travelling to the site, called Olympia, for the season of the games.

The site consisted of a stadium (for the games) and a sacred grove, or *Altis*, where temples were located. The shrine to Zeus was simple in the early years, but as time went by and the games increased in importance, it became obvious

that a new, larger temple, one worthy of the King of the gods, was needed. Between 470 and 460 B.C., construction on a new temple was started. The designer was Libon of Elis and his masterpiece, The Temple of Zeus was completed in 456 B.C.

This temple followed a design used on many large Greek temples. It was similar to the Parthenon in Athens and the Temple of Artemis in Ephesus. The temple was built on a raised, rectangular platform. Thirteen large columns supported the roof along the sides and six supported it on each end. A gently-peaked roof topped the building. The triangles, or 'pediments,' created by the sloped roof at the ends of the building were filled with sculpture. Under the pediments, just above the columns, was more sculpture depicting the twelve labours of Heracles, six on each end.

Though the temple was considered one of the best examples of the Doric design because of its style and the quality of the workmanship, it was decided the temple alone was too simple to be worthy of the King of the gods. To remedy this, a statue was commissioned for the interior–a magnificent statue of Zeus that would become one of the Seven Wonders of the Ancient World.

The sculptor chosen for this great task was a man named Phidias. He had already rendered a 40 feet high statue of the goddess Athena for the Parthenon in Athens and had also done much of the sculpture on the exterior of that temple. After his work in Athens was done, Phidias travelled to Olympia to start on what was considered his best work, the statue of Zeus. On arriving he set up a workshop to the west of the temple.

According to accounts, the statue was located at the western end of the temple. It was 22 feet wide and some 40 feet tall. The figure of Zeus was seated on an elaborate throne. His head nearly grazed the roof. The historian Strabo wrote, "...although the temple itself is very large, the sculptor is criticized for not having appreciated the correct proportions.

He has depicted Zeus seated, but with the head almost touching the ceiling, so that we have the impression that if Zeus moved to stand up he would unroof the temple..."

Others who viewed that temple disagreed with Strabo and found the proportions very effective in conveying the god's size and power. By filling nearly all the available space, the statue was made to seem even larger than it really was.

In its right hand the statue held the figure of Nike (the goddess of victory) and in its left was a scepter "inlaid with every kind of metal..." which was topped with an eagle. Perhaps even more impressive than the statue itself was the throne made out of gold, ebony, ivory and inlaid with precious stones. Carved into the chair were figures of Greek gods and mystical animals, like the sphinx.

The figure's skin was composed of ivory and the beard, hair and robe of gold. Construction was by the use of gold and ivory plates attached to a wooden frame. Because the weather in Olympia was so damp, the statue required care so that the humidity would not crack the ivory. For this purpose it was constantly treated with oil kept in a special pool in the floor of the temple. It is said that for centuries the decedents of Phidias held the responsibility for the maintenance of the statue.

Besides the statue, there was little inside the temple. The Greeks preferred the interior of their shrines to be simple.

Despite his magnificent work at Olympia, Phidias ran into trouble when he returned home. He was in close friendship with Pericles, who ruled the Athens. Enemies of Pericles, unable to strike at the ruler directly, attacked his friends instead. Phidias was accused of stealing gold meant for the statue of Athena. When that charge failed to stick, they claimed he had carved his image, and that of Pericles into the sculpture found on the Parthenon. This would have been improper in the Greeks' eyes and Phidias was thrown into jail where he died awaiting trial.

His masterpiece lived on, though, at the temple in

Olympia until 392 A.D. when the Olympics were abolished by Emperor Theodosius I of Rome, a Christian who saw the games as a pagan rite. After that the statue was moved by wealthy Greeks to the city of Constantinople where it survived until destroyed by fire in 462 A.D.

The first archaeological work on the Olympia site was done by a group of French archaeologist in 1829. They were able to locate the outlines of the temple and found fragments of the sculpture showing the labours of Heracles. These pieces were shipped to Paris where they are still on display today at the Louvre.

The next expedition came from Germany in 1875 worked at Olympia for five summers. Over that period they were able to map out most of the buildings there, discovered more fragments of the temple's sculpture, and located the remains of the pool in the floor that contained the oil for the statue.

In the 1950's an excavation uncovered the workstop of Phidias which was discovered beneath an early Christain Church. Archaeologists found sculptor's tools, a pit for casting bronze, clay molds, modelling plaster and even a portion of one of the elephant's tusks which had supplied the ivory for the statue. Many of the clay molds, which had been used to shape the gold plates, bore serial numbers which must have been used to show the place of the plates in the design.

Today the stadium at the site has been restored. Little is left of the temple, though, except a few columns. Of the statue, which was perhaps the most wonderful work at Olympia, all is now gone.

❐

4

The Temple of Artemis

1100 A.D.–A troop of Crusaders stops at a muddy little village in Asia Minor. Their leader looks around. Confused, he dismounts. This place is not what he expected. He read in the ancient texts that this was a large seaport with many ships docked in its bay. It isn't. The sea is almost three miles away. The village is located in a swamp. There are no ships to be seen. The leader accosts a nearby man.

"Sir, is this the city of Ephesus?"

"It was called that once. Now it is named Ayasalouk."

"Well, where is your bay? Where are the trading ships? And where is the magnificent Greek temple that we have heard about?"

Now it is the man's turn to be confused. "Temple? What temple, Sir? We have no temple here..."

And so 800 years after its destruction, the magnificent Temple of Artemis at Ephesus, one of the Seven Wonders of the Ancient World, had been completely forgotten by the people of the town that had once held it in such pride.

And there is no doubt that the temple was indeed magnificent. "I have seen the walls and Hanging Gardens of ancient Babylon," wrote Philon of Byzantium, "the statue of Olympian Zeus, the Colossus of Rhodes, the mighty work of the high Pyramids and the tomb of Mausolus. But when I saw the temple at Ephesus rising to the clouds, all these other wonders were put in the shade."

So what happened to this great temple? And what happened to the city that hosted it? What turned Ephesus from a busy port of trade to a few shacks in a swamp?

The first shrine to the Goddess Artemis was probably built around 800 B.C. on a marshy strip near the river at Ephesus. The Ephesus Goddess Artemis, sometimes called Diana, is not the same figure as the Artemis worshipped in Greece. The Greek Artemis is the goddess of the hunt. The Ephesus Artemis was a goddess of fertility and was often pictured as draped with eggs, or multiple breasts, symbols of fertility, from her waist to her shoulders.

That earliest temple contained a sacred stone, probably a meteorite, that had 'fallen from Jupiter.' The shrine was destroyed and rebuilt several times over the next few hundred years. By 600 B.C., the city of Ephesus had become a major port of trade and an architect named Chersiphron was engaged to build a new large temple. He designed it with high stone columns. Concerned that carts carrying the columns might get mired in the swampy ground around the site, Chersiphron laid the columns on their sides and had them rolled to where they would be erected.

This temple didn't last long. In 550 B.C. King Croesus of Lydia conquered Ephesus and the other Greek cities of Asia Minor. During the fighting, the temple was destroyed. Croesus proved himself a gracious winner, though, by contributing generously to the building of a new temple.

This was next to the last of the great temples to Artemis in Ephesus and it dwarfed those that had come before. The architect is thought to be a man named Theodorus. Theodorus' temple was 300 feet in length and 150 feet wide

with an area four times the size of the temple before it. More than one hundred stone columns supported a massive roof. The new temple was the pride of Ephesus until 356 B.C. when a tragedy, by name of Herostratus, struck.

Herostratus was a young Ephesian who would stop at no cost to have his name go down in history. He managed this by burning the temple to the ground. The citizens of Ephesus were so appalled at this act they issued a decree that anyone who spoke of Herostratus would be put to death.

Shortly after this horrible deed, a new temple was commissioned. The architect was Scopas of Paros, one of the most famous sculptors of his day. Ephesus was one of the greatest cities in Asia Minor at this point and no expense was spared in the construction. According to Pliny the Elder, a Roman historian, the temple was a "wonderful monument of Greek magnificence, and one that merits our genuine admiration."

The temple was built in the same marshy place as before. To prepare the ground, Pliny recorded that "layers of trodden charcoal were placed beneath, with fleeces covered with wool upon the top of them."

The building is thought to be the first completely constructed with marble and one of its must unusual features were 36 columns whose lower portions were carved with figures in high-relief. The temple also housed many works of art including four bronze statues of Amazon women.

Pliny recorded the length of this new temple at 425 feet and the width at 225 feet. Some 127 columns, 60 feet in height, supported the roof. In comparison the Parthenon, the remains of which stand on the acropolis in Athens today, was only 230 feet long, 100 feet wide and had 58 columns.

According to Pliny, construction took 120 years, though some experts suspect it may have only taken half that time. We do know that when Alexander the Great came to Ephesus in 333 B.C., the temple was still under construction. He offered to finance the completion of the temple if the city would credit him as the builder. The city fathers didn't want

Alexander's name carved on the temple, but didn't want to tell him that. They finally gave the tactful response: "It is not fitting that one god should build a temple for another god" and Alexander didn't press the matter.

Pliny reported that earthen ramps were employed to get the heavy stone beams perched on top of the columns. This method seemed to work well until one of the largest beams was put into position above the door. It went down crookedly and the architect could find no way to get it to lie flat. He was beside himself with worry about this until he had a dream one night in which the Goddess herself appeared to him saying that he should not be concerned. She herself had moved the stone in the proper position. The next morning the architect found that the dream was true. During the night the beam had settled into its proper place.

The city continued to prosper over the next few hundred years and was the destination for many pilgrims coming to view the temple. A souvenir business in miniature Artemis idols, perhaps similar to a statue of her in the temple, grew up around the shrine. It was one of these business proprietors, a man named Demetrius, that gave St. Paul a difficult time when he visited the city in 57 A.D.

St. Paul came to the city to win converts to the then new religion of Christianity. He was so successful that Demetrius feared the people would turn away from Artemis and he would lose his livelihood. He called others of his trade together with him and gave a rousing speech ending with "Great is Artemis of the Ephesians!" They then seized two of Paul's companions and a near riot followed. Eventually the city was quieted, the men released, and Paul left for Macedonia.

It was Paul's Christianity that won out in the end, though. By the time the great Temple of Artemis was destroyed during a raid by the Goths in 262 A.D., both the city and the religion of Artemis were in decline. When the Roman Emperor Constantine rebuilt much of Ephesus a century later, he declined to restore the temple. He had become a Christian and had little interest in pagan temples.

Despite Constantine's efforts, Ephesus declined in its importance as a crossroads of trade. The bay where ships docked disappeared as silt from the river filled it. In the end what was left of the city was miles from the sea, and many of the inhabitants left swampy lowland to live in the surrounding hills. Those that remained used the ruins of the temple as a source of building materials. Many of the fine sculptures were pounded into powder to make lime for wall plaster.

In 1863 the British Museum sent John Turtle Wood, an architect, to search for the temple. Wood met with many obstacles. The region was infested with bandits. Workers were hard to find. His budget was too small. Perhaps the biggest difficulty was that he had no idea where the temple was located. He searched for the temple for six years. Each year the British Museum threatened to cut off his funding unless he found something significant, and each year he convinced them to fund him for just one more season.

Wood kept returning to the site each year despite many hardships. During his first season he was thrown from a horse, breaking his collar bone. Two years later he was stabbed within an inch of his heart during an assassination attempt upon the British Consul in Smyrna.

Finally in 1869, at the bottom of a muddy twenty-foot deep test pit, his crew struck the base of the great temple. Wood then excavated the whole foundation removing 132,000 cubic yards of the swamp to leave a hole some 300 feet wide and 500 feet long. The remains of some of the sculptured portions were found and shipped to the British Museum where they can be viewed even today.

In 1904 another British Museum expedition under the leadership of D.G. Hograth continued the excavation. Hograth found evidence of five temples on the site, each constructed on top of the other.

Today the site of the temple is a marshy field. A single column is erect to remind visitors that once there stood in that place one of the wonders of the ancient world.

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5

The Mausoleum at Halicarnassus

In 377 B.C., the city of Halicarnassus was the capital of a small kingdom along the Mediterranean coast of Asia Minor. It was in that year the ruler of this land, Hecatomnus of Mylasa, died and left control of the kingdom to his son, Mausolus. Hecatomnus, a local satrap to the Persians, had been ambitious and had taken control of several of the neighbouring cities and districts. Mausolus in his time, extended the territory even further so that it finally included most of southwestern Asia Minor.

Mausolus, with his queen Artemisia, ruled over Halicarnassus and the surrounding territory for 24 years. Mausolus, though he was descended from the local people, spoke Greek and admired the Greek way of life and government. He founded many cities of Greek design along the coast and encouraged Greek democratic traditions.

Then in 353 B.C. Mausolus died, leaving his queen Artemisia, who was also his sister (It was the custom in Caria for rulers to marry their own sisters), broken-hearted. As a

tribute to him, she decided to build the most splendid tomb in the known world. It became a structure so famous that Mausolus's name is now associated with all stately tombs through our modern word mausoleum. The building was also so beautiful and unique it became one of the Seven Wonders of the Ancient World.

Artemisia decided that no expense was to be spared in the building of the tomb. She sent messengers to Greece to find the most talented artists of the time. This included Scopas, the man who had supervised the rebuilding of the Temple to Artemis at Ephesus. Other famous sculptors such as Bryaxis, Leochares and Timotheus joined him as well as hundreds of other craftsmen.

The tomb was erected on a hill overlooking the city. The whole structure sat in an enclosed courtyard. At the centre of the courtyard was a stone platform on which the tomb itself sat. A staircase, flanked by stone lions, led to the top of this platform. Along the outer wall of this were many statues depicting gods and goddess. At each corner stone warriors, mounted on horseback, guarded the tomb.

At the centre of the platform was the tomb itself. Made mostly of marble, the structure rose as a square, tapering block to about one-third of the Mausoleum's 140 feet height. This section was covered with relief sculpture showing action scenes from Greek myth/history. One part showed the battle of the Centaurs with the Lapiths. Another depicted Greeks in combat with the Amazons, a race of warrior women.

On top of this section of the tomb thirty-six slim columns, nine per side, rose for another third of the height. Standing in between each column was another statue. Behind the columns was a solid block that carried the weight of the tomb's massive roof. The roof, which comprised most of the final third of the height, was in the form of a stepped pyramid. Perched on top was the tomb's penultimate work of sculpture: Four massive horses pulling a chariot in which images of Mausolus and Artemisia rode.

Soon after construction of the tomb started Artemisia

found herself in a crisis. Rhodes, an island in the Aegean Sea between Greece and Asia Minor, had been conquered by Mausolus. When the Rhodians heard of his death they rebelled and sent a fleet of ships to capture the city of Halicarnassus. Knowing that the Rhodian fleet was on the way, Artemisa hid her own ships at a secret location at the east end of the city's harbour. After troops from the Rhodian fleet disembarked to attack, Artemisia's fleet made a surprise raid, captured the Rhodian fleet, and towed it out to sea.

Artemisa put her own soldiers on the invading ships and sailed them back to Rhodes. Fooled into thinking that the returning ships were their own victorious navy, the Rhodians failed to put up a defence and the city was easily captured quelling the rebellion. Artemisa lived for only two years after the death of her husband. Both would be buried in the yet unfinished tomb. According to the historian Pliny, the craftsmen decided to stay and finish the work after their patron died "considering that it was at once a memorial of their own fame and of the sculptor's art."

The Mausoleum overlooked the city of Halicarnassus for many centuries. It was untouched when the city fell to Alexander the Great in 334 B.C. and still undamaged after attacks by pirates in 62 and 58 B.C. It stood above the city ruins for some 17 centuries. Then a series of earthquakes shattered the columns and sent the stone chariot crashing to the ground. By 1404 A.D. only the very base of the Mausoleum was still recognizable.

Crusaders, who had occupied the city from the thirteen century onwards, recycled the broken stone into their own buildings. In 1522 rumours of a Turkish invasion caused Crusaders to strengthen the castle at Halicarnassus (which was by then known as Bodrum) and much of the remaining portions of the tomb was broken up and used within the castle walls. Indeed sections of polished marble from the tomb can still be seen there today.

At this time a party of knights entered the base of the monument and discovered the room containing a great

coffin. The party, deciding it was too late to open it that day, returned the next morning to find the tomb, and any treasure it may have contained, plundered. The bodies of Mausolus and Artemisia were missing too. The Knights claimed that Moslem villagers were responsible for the theft, but it is more likely that some of the Crusaders themselves plundered the graves.

Before grounding much of the remaining sculpture of the Mausoleum into lime for plaster the Knights removed several of the best works and mounted them in the Bodrum castle. There they stayed for three centuries. At that time the British ambassador obtained several of the statutes from the castle, which now reside in the British Museum.

In 1846 the Museum sent the archaeologist Charles Thomas Newton to search for more remains of the Mausoleum. He had a difficult job. He didn't know the exact location of the tomb and the cost of buying up all the small parcels of land in the area to look for it would have been astronomical. Instead Newton studied the accounts of ancient writers like Pliny to obtain the approximate size and location of the memorial, then bought a plot of land in the most likely location. Digging down, Newton explored the surrounding area through tunnels he dug under the surrounding plots. He was able to locate some walls, a staircase, and finally three of the corners of the foundation. With this knowledge, Newton was able to figure out which plots of land he needed to buy.

Newton then excavated the site and found sections of the reliefs that decorated the wall of the building and portions of the stepped roof. Also a broken stone chariot wheel, some seven feet in diameter, from the sculpture on the roof was discovered. Finally, he found the statues of Mausolus and Artemisia that had stood at the pinnacle of the building.

Today these works of art stand in the Mausoleum Room at the British Museum. There the images of Mausolus and his queen forever watch over the few broken remains of the beautiful tomb she built for him.

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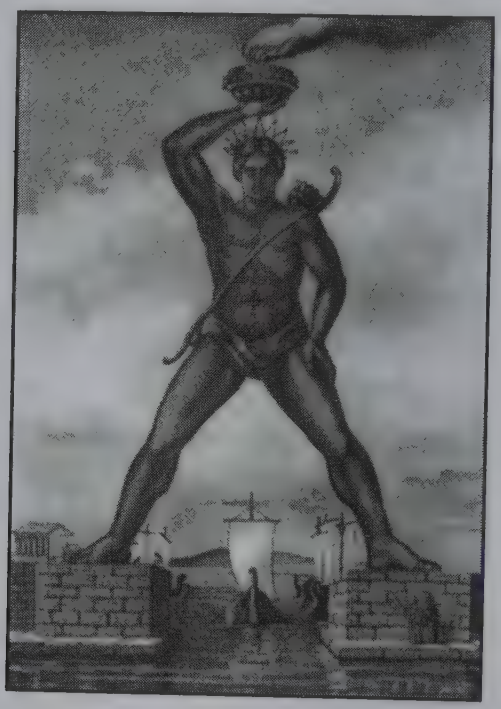
6

The Colossus of Rhodes

Travellers to New York City harbour see a marvellous sight. Standing on a small island in the harbour is an immense statue of a robed woman, holding a book and lifting a torch to the sky. The statue measures almost 120 feet from foot to crown. It is sometimes referred to as the 'Modern Colossus,' but more often called the Statue of Liberty.



This awe-inspiring statue was a gift from France to America and is easily recognized by people around the world. What many visitors to this shrine to freedom don't know is that the statue, the 'Modern Colossus,' is the echo of another statue, the original colossus that stood over two thousand years ago at the entrance to another busy harbour on the Island of Rhodes. Like the Statue of Liberty, this colossus was also built as a celebration of freedom. This amazing statue, standing the same height from toe to head

as the modern colossus, was one of the Seven Wonders of the Ancient World.

The island of Rhodes was an important economic centre in the ancient world. It is located off the southwestern tip of Asia Minor where the Aegean Sea meets the Mediterranean. The capitol city, also named Rhodes, was built in 408 B.C. and was designed to take advantage of the island's best natural harbour on the northern coast.

In 357 B.C. the island was conquered by Mausolus of Halicarnassus (whose tomb is one of the other Seven Wonders of the Ancient World), fell into Persian hands in 340 B.C., and was finally captured by Alexander the Great in 332 B.C. When Alexander died of a fever at an early age, his generals fought bitterly among themselves for control of Alexander's vast kingdom. Three of them, Ptolemy, Seleucus, and Antigous, succeeded in dividing the kingdom among themselves.

The Rhodians supported Ptolemy (who wound up ruling Egypt) in this struggle. This angered Antigous who sent his son Demetrius to capture and punish the city of Rhodes.

The war was long and painful. Demetrius brought an army of 40,000 men. This was more than the entire population of Rhodes. He also augmented his force by using Aegean pirates.

The city was protected by a strong, tall, wall and the attackers were forced to use siege towers to try and climb over it. Siege towers were wooden structures often armed with catapults that could be moved up to a defender's walls to allow the attackers to scale them. While some were designed to be rolled up on land, Demetrius used a giant tower mounted on top of six ships lashed together to make his attack. This tower, though, was turned over and smashed when a storm suddenly approached. The battle was won by the Rhodians.

Demetrius had a second supertower built. This one stood almost 150 feet high and some 75 feet square at the base. It

was equipped with many catapults and skinned with wood and leather to protect the troops inside from archers. It even carried water tanks that could be used to fight fires started by flaming arrows. This tower was mounted on iron wheels and could be rolled up to the walls.

When Demetrius attacked the city, the defenders stopped the war machine by flooding a ditch outside the walls and miring the heavy monster in the mud. By then almost a year had gone by and a fleet of ships from Egypt arrived to assist the city. Demetrius withdrew quickly leaving the great siege tower where it was.

To celebrate their victory and freedom, the Rhodians decided to build a giant statue of their patron god Helios. They melted down bronze from the many war machines Demetrius left behind for the exterior of the figure and the super siege tower became the scaffolding for the project. According to Pliny, a historian who lived several centuries after the Colossus was built, construction took 12 years. Other historians place the start of the work in 304 B.C.

The statue was 110 feet high and stood upon a 50 foot pedestal near the harbour mole. Although the statue has been popularly depicted with its legs spanning the harbour entrance so that ships could pass beneath, it was actually posed in a more traditional Greek manner: nude, wearing a spiked crown, shading its eyes from the rising sun with its right hand, while holding a cloak over its left.

No ancient account mentions the harbour-spanning pose and it seems unlikely the Greeks would have depicted one of their gods in such an awkward manner. In addition, such a pose would mean shutting down the harbour during the construction, something not economically feasible.

The statue was constructed of bronze plates over an iron framework (very similar to the Statue of Liberty which is copper over a steel frame). According to the book of Pilon of Byzantium, 15 tons of bronze were used and 9 tons of iron, though these numbers seem low. The Statue of Liberty,

roughly of the same size, weighs 225 tons. The Colossus, which relied on weaker materials, must have weighed at least as much and probably more.

Ancient accounts tell us that inside the statue were several stone columns which acted as the main support. Iron beams were driven into the stone and connected with the bronze outer skin. Each bronze plate had to be carefully cast then hammered into the right shape for its location in the figure, then hoisted into position and riveted to the surrounding plates and the iron frame.

The architect of this great construction was Chares of Lindos, a Rhodian sculptor who was a patriot and fought in defence of the city. Chares had been involved with large scale statues before. His teacher, Lysippus, had constructed a 60 feet high likeness of Zeus. Chares probably started by making smaller versions of the statue, maybe three feet high, then used these as a guide to shaping each of the bronze plates of the skin.

It is believed Chares did not live to see his project finished. There are several legends that he committed suicide. In one tale he has almost finished the statue when someone points out a small flaw in the construction. The sculptor is so ashamed of it he kills himself.

In another version the city fathers decide to double the height of the statue. Chares only doubles his fee, forgetting that doubling the height will mean an eightfold increase in the amount of materials needed. This drives him into bankruptcy and suicide.

There is no evidence that either of these tales are true.

The Colossus stood proudly at the harbour entrance for some fifty-six years. Each morning the sun must have caught its polished bronze surface and made the god's figure shine. Then an earthquake hit Rhodes and the statue collapsed. Huge pieces of the figure lay along the harbour for centuries.

"Even as it lies," wrote Pliny, "it excites our wonder and

admiration. Few men can clasp the thumb in their arms, and its fingers are larger than most statues. Where the limbs are broken asunder, vast caverns are seen yawning in the interior. Within it, too, are to be seen large masses of rock, by the weight of which the artist steadied it while erecting it."

It is said that an Egyptian king offered to pay for its reconstruction, but the Rhodians refused. They feared that somehow the statue had offended the god Helios, who used the earthquake to throw it down.

In the seventh century A.D. the Arabs conquered Rhodes and broke the remains of the Colossus up into smaller pieces and sold it as scrap metal. Legend says it took 900 camels to carry away the statue. A sad end for what must have been a majestic work of art.

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7

The Great Lighthouse at Alexandria

In the fall of 1994 a team of archaeological scuba divers entered the waters off of Alexandria, Egypt. Working beneath the surface they searched the bottom of the sea for artefacts. Large underwater blocks of stone were marked with floating masts so that an Electronic Distance Measurement station on shore could obtain their exact positions. Global positioning satellites were used to further fix the locations. The information was then fed into computers to create a detailed database of the sea floor.

Ironically, these scientists were using some of the most high-tech devices available at the end of the 20th century to try and discover the ruins of one of the most advanced technological achievements of the 3rd century, B.C.–The

Pharos. It was the great lighthouse of Alexandria, one of the Seven Wonders of the Ancient World.

The story of the Pharos starts with the founding of the city of Alexandria by the Macedonian conqueror Alexander the Great in 332 B.C. Alexander started at least 17 cities named Alexandria at different locations in his vast domain. Most of them disappeared, but Alexandria in Egypt thrived for centuries and continues even today.

Alexander the Great choose the location of his new city carefully. Instead of building it on the Nile delta, he selected a site some twenty miles to the west, so that the silt and mud carried by the river would not block the city harbour. South of the city was the marshy Lake Mareotis. After a canal was constructed between the lake and the Nile, the city had two harbours: one for Nile River traffic, and the other for Mediterranean Sea trade. Both harbours would remain deep and clear.

Alexander died soon after in 323 B.C. and the city was completed by Ptolemy Soter the new ruler of Egypt. Under Ptolemy the city became rich and prosperous. However, it needed both a symbol and a mechanism to guide the many trade ships into the busy harbour. Ptolemy authorized the building of the Pharos in 290 B.C., and when it was completed some twenty years later, it was the first lighthouse in the world and the tallest building in existence, with the exception of the Great Pyramid.

The lighthouse's designer was Sostrates of Knidos. Proud of his work, Sostrates, desired to have his name carved into the foundation. Ptolemy II, the son who ruled Egypt after his father, refused this request wanting his own name to be the only one on the building. A clever man, Sostrates had the inscription:

Sostrates son of Dexiphanes of Knidos on behalf of all mariners to the saviour gods

chiseled into the foundation, then covered it with plaster.

Into the plaster was chiseled Ptolemy's name. As the years went by the plaster aged and chipped away revealing Sostrates' declaration.

The lighthouse was built on the Island of Pharos and soon the building itself acquired the name. The connection of the name with the function became so strong that the word 'Pharos' became the root of the word 'lighthouse' in the French, Italian, Spanish and Romanian languages.

There are two detailed descriptions made of the lighthouse in the 10th century A.D. by Moorish travellers Idrisi and Yusuf Ibn al-Sheikh. According to their accounts, the building was 300 cubits high. Because the cubit measurement varied from place to place, this could mean that the Pharos stood anywhere from 450 to 600 feet in height, although the lower figure is more likely.

The design was unlike the slim single column of most modern lighthouses, but more like the structure of an early twentieth century skyscraper. There were three stages, each built on top of the lower. The building was constructed of marble blocks with lead mortar. The lowest level was probably more that 200 feet in height and 100 feet square, shaped like a massive box. Inside this section was a large spiral ramp that allowed materials to be pulled to the top in horse-drawn carts.

On top of this section was an eight-sided tower. On top of the tower was a cylinder that extended up to an open cupola where the fire that provided the light burned. On the roof of the cupola was a large statue of Poseidon. The lower portion of the building contained hundreds of storage rooms.

The interior of the upper two sections had a shaft with a dumbwaiter that was used to transport fuel up to the fire. Staircases allowed visitors and the keepers to climb to the beacon chamber. There, according to reports, a large curved mirror, perhaps made of polished metal, was used to project the fire's light into a beam. It was said ships could detect the

light from the tower at night or the smoke from the fire during the day up to 100 miles away.

There are stories that this mirror could be used as a weapon to concentrate the sun and set enemy ships ablaze as they approached. Another tale says that it was possible to use the mirror to magnify the image of the city of Constantinople from far across the sea to observe what was going on there. Both of these stories seem implausible, though.

The lighthouse was apparently a tourist attraction. Food was sold to visitors at the observation platform at the top of the first level. A smaller balcony provided a view from the top of the eight-sided tower for those that wanted to make the additional climb. The view from there must have been impressive as it was probably 300 feet above the sea. There were few places in the ancient world where a person could ascend a man-made tower to get such a perspective.

How then did the world's first lighthouse wind up on the floor of the Mediterranean Sea? Most accounts indicate that it, like many other ancient buildings, was the victim of earthquakes. It stood for 1,500 years but was damaged by tremors in 365 and 1303 A.D. Reports indicate the final collapse came in 1326.

There is also an unlikely tale that part of the lighthouse was demolished through trickery. In 850 A.D. the Emperor of Constantinople, a rival port, devised a clever plot to get rid of the Pharos. He spread rumours that buried under the lighthouse was a fabulous treasure. When the Caliph at Cairo who controlled Alexandria heard these rumours, he ordered that the tower be pulled down to get at the treasure. It was only after the great mirror had been destroyed and the top two portions of the tower removed that the Caliph realized he'd been deceived. He tried to rebuild the tower, but couldn't, so he turned it into a mosque instead.

As colourful as this story is there does not seem to be

much truth in it. Visitors in 1115 A.D. reported the Pharos intact and still operating as a lighthouse.

Did the divers actually find the remains of Pharos in the bottom of the harbour? Some of the larger blocks of stone found certainly seem to have come from a large building. Statues were located that may have stood at the base of the Pharos. Interestingly enough, much of the material found seems to be from earlier eras than the lighthouse. Scientists speculate that they may have been recycled in the construction of the Pharos from even older buildings.

There are plans to turn this site into an archaeological park with a lighthouse museum. In a few years visitors maybe able to rent snorkle gear and wet suits and dive in the bay among the remains of the great Pharos lighthouse.

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The Seven Wonders of the Medieval Mind

The medieval mind, just like the classical mind before it, was captivated by the wondrous things people had made. For much of the thousand-year period known as the Middle Ages, most Europeans lived in small, isolated communities; travel was difficult and often dangerous; and knowledge was confined to, and often controlled by men of the church. The great civilizations of Greece and Rome were long gone, but even so, some of their glory was still remembered. Travellers brought back tales of an incredible civilization in the East which sparked the European imagination.

Following the third century B.C. when lists of wonders were compiled, many scholars and philosophers modified these lists to reflect their own opinions. At some point around the Middle Ages, another list appeared–the medieval world's seven wonders.

The surviving list holds a particular fascination because only some of its marvels actually date from the Middle Ages. The list represents almost 4,500 years of human endeavour.

1

Stonehenge

Stonehenge, monumental circular setting of large standing stones surrounded by a circular earthwork, built in prehistoric times beginning about 3100 B.C. and located about 8 miles north of Salisbury, Wiltshire, England. The modern interpretation of the monument is based chiefly on excavations carried out since 1919 and especially since 1950.

The Stonehenge that visitors see today is considerably ruined, many of its stones having been pilfered by medieval and early modern builders (there is no natural building stone within 21 km. of Stonehenge); its general architecture has also been subjected to centuries of weathering and depredation.

The monument consists of a number of structural elements, mostly circular in plan. On the outside is a circular ditch, with a bank immediately within it, all interrupted by an entrance gap on the northeast, leading to the Avenue. At

the centre of the circle is a stone setting consisting of a horseshoe of tall uprights of sarsen (Tertiary sandstone) encircled by a ring of tall sarsen uprights, all originally capped by horizontal sarsen lintels. Within the sarsen stone circle were also configurations of smaller and lighter bluestones (igneous rock of diabase, rhyolite, and volcanic ash), but most of these bluestones have disappeared. Additional stones include the so-called Altar Stone, the Slaughter Stone, two Station Stones, and the Heel Stone, the last standing on the Avenue outside the entrance. Small circular ditches enclose two flat areas on the inner edge of the bank, known as the North and South barrows, with empty stone holes at their centres.

Why Stonehenge was built is unknown, though it probably was constructed as a place of worship of some kind. Notions that it was built as a temple for Druids or Romans are unsound, because neither was in the area until long after Stonehenge was last constructed. Early in the 20th century, the English astronomer Sir Norman Lockyer demonstrated that the northeast axis aligned with the sunrise at the summer solstice, leading other scholars to speculate that the builders were sun worshippers. In 1963 an American astronomer, Gerald Hawkins, purported that Stonehenge was a complicated computer for predicting lunar and solar eclipses. These speculations, however, have been severely criticized by most Stonehenge archaeologists. "Most of what has been written about Stonehenge is nonsense or speculation," said R.J.C. Atkinson, archaeologist from University College, Cardiff. "No one will ever have a clue what its significance was."

❐

2

The Colosseum

The Colosseum or Flavian Amphitheater was begun by Vespasian, inaugurated by Titus in 80 A.D. and completed by Domitian. Located on marshy land between the Esquiline and Caelian Hills, it was the first permanent amphitheater to be built in Rome. Its monumental size and grandeur as well as its practical and efficient organization for producing spectacles and controlling the large crowds make it one of the great architectural monuments achieved by the ancient Romans.

The amphitheater is a vast ellipse with tiers of seating for 50,000 spectators around a central elliptical arena. Below the wooden arena floor, there was a complex set of rooms and passageways for wild beasts and other provisions for staging the spectacles. Eighty walls radiate from the arena and support vaults for passageways, stairways and the tiers of seats. At the outer edge circumferential arcades link each level and the stairways between levels.

The three tiers of arcades are faced by three-quarter columns and entablatures, Doric in the first story, Ionic in

the second, and Corinthian in the third. Above them is an attic story with Corinthian pilasters and small square window openings in alternate bays. At the top brackets and sockets carry the masts from which the velarium, a canopy for shade, was suspended.

The construction utilized a careful combination of types–concrete for the foundations, travertine for the piers and arcades, tufa infill between piers for the walls of the lower two levels, and brick-faced concrete used for the upper levels and for most of the vaults.

The Colosseum was designed to hold 50,000 spectators, and it had approximately eighty entrances so crowds could arrive and leave easily and quickly.

The plan is a vast ellipse, measuring externally 188m x 156m, with the base of the building covering about 2.4 hactares. Vaults span between eighty radial walls to support tiers of seating and for passageways and stairs.

The facade of three tiers of arches and an attic story is about 48.5m tall–roughly equivalent to a 12-15 storey building. ❐

3

The Catacombs of Kom el Shoqafa

Alexandria, Egypt, represented a melding of cultures in the late first century A.D. Traditions of Greece and Rome overlay the city, the cult of Christianity was gaining ground, and memories of ancient Egypt's great kingdoms still lingered. It was a place where people seemed to have a talent for combining rather than destroying cultures.

Little of that 'Paris of Antiquity' has survived above the ground. Below it, however, are haunting reminders of a culture that existed 1,900 years ago: the Catacombs of Kom el Shoqafa, 'Mound of Shards.' Carved out of solid rock, three levels burrow into the ground near the sites of the ancient stadium, and the long-vanished temple to Serapis, a

Greek and Egyptian god. Many such catacombs once filigreed Alexandria's underground, but earthquakes and construction projects destroyed or obscured them. Only in 1900 was Kom el Shoqafa rediscovered after centuries by a donkey that fell through a hole in the ground and into its access well. The animal, it soon became clear, had made an extraordinary archeological find.

An ancient circular staircase leads down into the catacombs. In the late second century, when Kom el Shaqafa was an active burial site, bodies were lowered by rope down the well formed by the spiraling stairs. The staircase ends at a landing vestibule, where two benches are carved into wall niches overarched by the cockleshell motif often found in classical designs.

A rotunda pierced by a six-pillared central shaft opens off the vestibule. To the left lies the *triclinium*, the funeral banquet hall where friends and family gathered on stone couches covered with cushions. Here they reclined while ceremonially feasting in memory of the deceased. Scholars believe that the catacombs at first may have served one family, but they were expanded into a mass burial site, probably administered by a corporation with dues-paying members. This theory could explain why so many chambers were hewn from the rock.

A staircase from the rotunda descends to the second level, an area eerily alive with sculpture. In the vestibule, two pillars are topped by the papyrus, lotus, and acanthus leaves of ancient Egypt, their frieze adorned by two falcons flanking a winged sun. Carved into wall niches are figures of a man, and a woman, perhaps the tomb's original occupants. The man's body assumes the stiff hieratic pose found in ancient Egyptian sculpture, but his head is in the lifelike manner of the classic Hellenes; the woman's stance is also rigid, but she sports a Roman hairstyle.

Three gigantic sarcophagi with lids that do not lift rest along the sides of the chamber. Scholars assume that bodies

would have been inserted into them from behind, using a passageway that runs around the outside of the funeral chamber. Further circling this central tomb chamber is a hallway with 91 wall niches, each one providing burial space for three mummies.

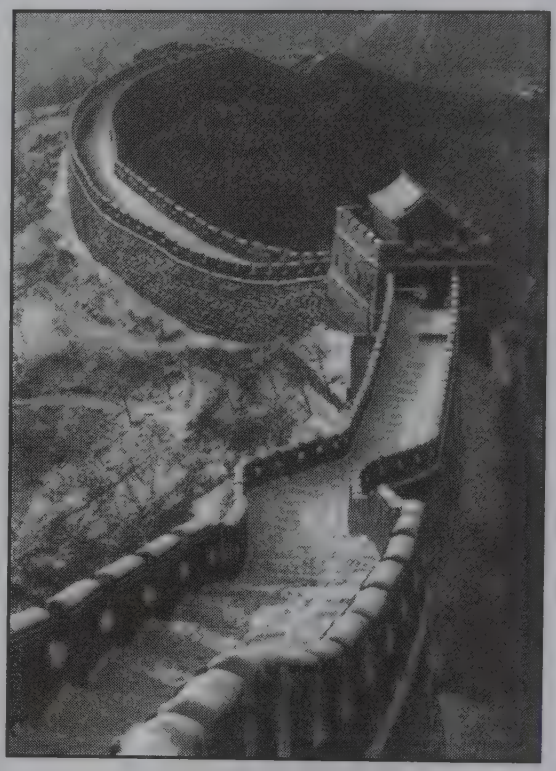
Returning to the first level, visitors can reach a separate set of tombs through a breach in the rotunda wall, unintended by the original builders. It leads to what has been called the Hall of Caracalla, where bones of horses and humans were found. The hall's name comes from an episode in A.D. 215, when Emperor Caracalla ordered Alexandrian youths to review, then massacred them.

❐

4

The Great Wall of China

After subjugating and uniting China from seven Warring States, the emperor connected and extended four old fortification walls along the north of China that originated about 700 B.C. (over 2500 years ago). Armies were stationed along the wall as a first line of defence against the invading nomadic Hsiung Nu tribes north of China (the Huns). Signal fires from the Wall provided early warning of an attack.



The Great Wall is one of the largest building construction projects ever completed. It stretches across the mountains of northern China, winding north and northwest of Beijing. It was over 5,000 km (=10,000 Li) long. Its thickness ranged from about 4.5 to 9 meters and was up to 7.5 meters tall.

During the Ming Dynasty (1368-1644), the Great Wall was enlarged to 6,400 kilometers and renovated over a 200 year period, with watch-towers and cannons added.

The Great Wall can be seen from Earth orbit, but, contrary to legend, is not visible from the moon, according to astronauts Neil Armstrong, Jim Lovell, and Jim Irwin.

❐

5

The Porcelain Tower of Nanjing

The people of China called it *Bao'ensi*, the 'Temple of Gratitude.' European visitors who beheld the structure called it the Porcelain Tower of Nanjing and labeled it one of the wonders of the world. But warfare and subsequent destruction overtook it in the 19th century, and this remarkable structure was almost lost to history, virtually forgotten by the world.

Still, for many people who had known the tower firsthand, it was a sublimely elegant example of a Buddhist pagoda. "The best contrived and noblest structure of all the East," wrote Le Comte, the French mathematician who had made a visit to China in the early 19th century.

From an octagonal base about 97 feet in diameter, the

tower's nine stories rose pyramidally to a height of about 260 feet. According to information obtained by an American missionary who journeyed to Nanjing in 1852, the original plan for the tower had called for 13 stories and a total height of about 330 feet. Although those ambitious dimensions were never realized, the smaller size made little difference, because size was not what made the structure so memorable for visitors.

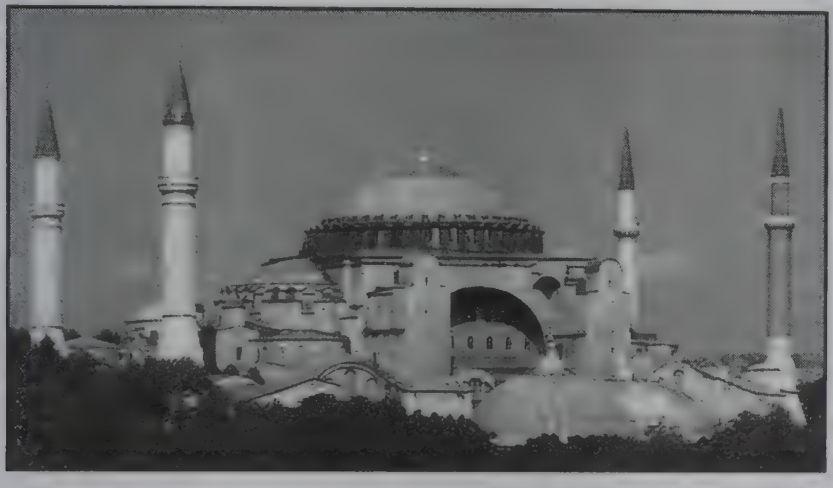
The brilliant white porcelain bricks that faced the tower were what made it so unforgettable. By day, the bricks glittered in the sun, and at night they were illuminated by perhaps as many as 140 lamps hanging around the exterior of the pagoda. Worked into the porcelain panels were colourful stoneware tiles with green, yellow, white, and brown glazes forming images of animals, landscapes, flowers, and bamboo.

❐

6

The Hagia Sophia

Probably Istanbul's most famous landmark, the Hagia Sophia (also spelled Ayasofya) was built by the emperor Justinian I in the year 537 A.D. Built in only six years, the structure was designed by the architects Anthemius of Tralles and Isidore of Miletus. On May 7, 558, the dome of the church collapsed due to a December 557 earthquake, and though a new dome was quickly rebuilt, historical records tell us that it was not identical to the original.



During the spring and summer of 1996, Marcus Hurley (Princeton class of 1997) created a detailed computer model of the Hagia Sophia using the Pro/ENGINEER modeling program. The model is intended to serve in a number of functions. It will be used in structural, finite element analysis of the church, can be used in visualization and walk throughs, and provides a mobile, multi-media tool for scholars interested in Byzantine architecture. Finally, it provides a useful illustration in determining the form of original structure.

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7

The Leaning Tower of Pisa

Bonnano Pisano, the engineer in charge, sought to compensate for the lean by making the new stories slightly taller on the short side, but the extra masonry caused the structure to sink still further. Work was suspended several times as engineers sought solutions, but the tower was ultimately topped out in the 14th century, still leaning.

In modern times the foundations have been strengthened by the injection of cement grouting, but in the late 20th century the structure was still in danger of collapse, and various schemes were being considered to save it.

❐

The Seven Natural Wonders of the World

The world's natural wonders differ from the other grouping of wonders in that they were not made or improved upon by humans. They actually humble humanity.

The local native peoples have known these wonders for millenia, however this list came to the notice of the Western world relatively recently. For example, Mount Everest wasn't identified as the world's highest peak until 1852, and its exact height is periodically disputed to this day.

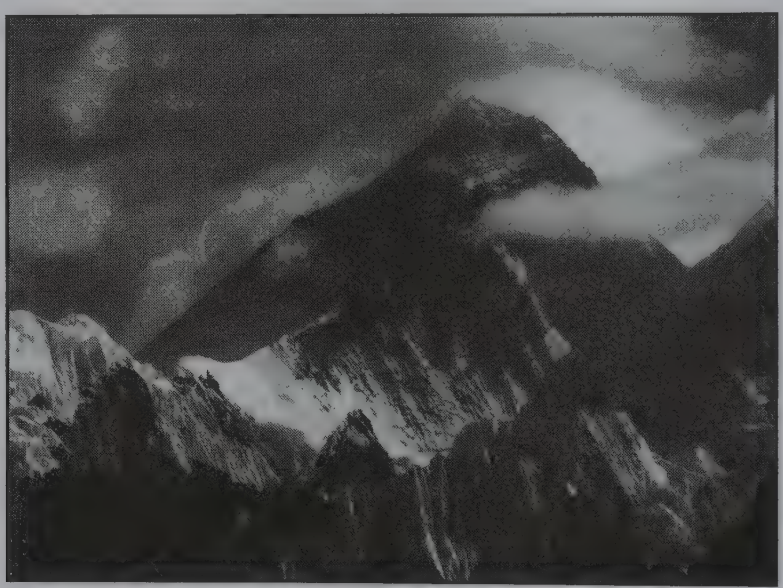
Today, these wonders have become places of pilgrimage, where awe is its own reward.

1

Mount Everest

Mount Everest, peak on the crest of the Great Himalaya Range in Asia, the highest point on Earth. It lies on the border between Nepal and China (Tibet).

Three barren ridges–the Southeast, Northeast, and West–culminate in two summits at 8,848m; Everest and 8,748m; South Peak. The mountain can be seen directly from its northeastern side, where it rises about 3,600m above the Plateau of Tibet. The lesser peaks of Changtse (north; 7,560m), Khumbutse (northwest; 6,665m), Nuptse (southwest; 7,861m), and Lhotse (south; 8,501m), which rise around its base, hide the summit from Nepal.



The summit of Everest reaches up two-thirds of the way through the air of the Earth's atmosphere to where oxygen levels are low. Lack of oxygen, powerful winds, and extremely cold temperatures preclude the development of any plant or animal life on the upper slopes. Precipitation falls as snow during the summer monsoon (May-September). The flanks

of the mountain are separated from each other by the main ridges; ice sheets on them cover the slopes to the mountain's base. The summit itself consists of rock-hard snow surmounted by a layer of snow that fluctuates annually by some 1.5-2m; it is highest in September and lowest in May after depletion by the strong northwesterly winter winds.

Individual glaciers around Mount Everest are the Kangshung Glacier (east); the East, main, and West Rongbuk glaciers (north and northwest); the Pumori Glacier (northwest); the Khumbu Glacier (west and south); and the West Cwm, an enclosed valley of ice between Everest and the Lhotse-Nuptse Ridge.

The mountain's drainage pattern radiates to the southwest, north, and east. The Khumbu Glacier melts into the Lobujya (Lobuche) River of Nepal, which flows southward as the Imja River to its confluence with the Dudh Kosi River. In Tibet, the Rong Chu River originates from the Pumori and Rongbuk glaciers, and the Karma Chu River from the Kangshung Glacier. The Rong Chu and Dudh Kosi river valleys form, respectively, the northern and southern access routes to the summit.

Mount Everest is revered by local peoples; it is called Chomolungma in Tibetan and Sagarmatha in Nepali, both meaning 'Goddess Mother of the World.' Its identity as the highest point on the Earth's surface was not recognized, however, until 1852, when the governmental Survey of India established that fact. In 1865 the mountain–previously referred to as Peak XV–was renamed for Sir George Everest, British surveyor general of India from 1830 to 1843. Controversy over the exact altitude of the summit developed because of variations in snow level, gravity deviation, and light refraction. The figure currently accepted–8,708m (plus or minus a fraction)–was established by the Survey of India between 1952 and 1955.

Attempts to climb Everest began with the opening of the Tibetan route in 1920. Seven successive attempts on the

Northeast Ridge (1921-38) and three missions up the Southeast Ridge (1951-52) failed because of the combined difficulties caused by cold arid air, high winds, difficult terrain, and high altitude.

Everest was finally surmounted in 1953, as the result of efforts by an expedition sponsored by the Royal Geographical Society and the Joint Himalayan Committee of the Alpine Club. Open- and closed-circuit oxygen systems, specially insulated boots and clothing, and portable radio equipment were used by the climbers. Eight camps were established on the route that was taken up the Khumbu Icefall and Glacier, the West Cwm, and the face of Lhotse to the South Col, a rocky ridge at about 8,000m. From there, on May 29, 1953, Edmund (later Sir Edmund) Hillary of New Zealand and Tenzing Norgay of Nepal ascended the Southeast Ridge, past South Peak, to the summit.

The first successful American expedition was in 1963. James W. Whittaker and Nawang Gombu of Nepal were the first to the top (May 1). Four climbers reached the summit on May 22; one pair, Thomas F. Hornbein and William F. Unsoeld, climbed the mountain by the previously unscaled West Ridge and returned by the South Col, completing the first transverse crossing. Since then, numerous expeditions sponsored by different countries have been undertaken. Tabei Junko of Japan, accompanied by Ang Tsering of Nepal, became the first woman to reach the summit (May 16, 1975), two British climbers first surmounted the southwest face (Sept. 25, 1975), and two Japanese made the first ascent by the North Wall on the Tibetan side (May 11, 1980).

❐

2

The Amazon Rain Forests

The Amazon is a region of superlatives. It spans the borders of eight countries and one overseas territory, is the world's largest river basin and the source of one-fifth of all free-flowing fresh water on Earth. Its rain forests are the planet's largest and most luxuriant, and home to one in ten known species on Earth.

Scientific research has established a clear link between the health of the Amazon and the integrity of the global environment, but still only a fraction of its biological richness has been revealed. Today, rapid deforestation threatens the Amazon. At current rates, 55 percent of its rain forests could be gone by 2030–a looming disaster not only for the region's plants and animals, but for the world.

The region's high levels of rainfall, diverse topography and meandering rivers sustain its amazing variety and abundance of life. The Amazon contains vast stores of carbon–its rain forests are key to stabilizing local and global climate.

Containing nearly 40,000 plant species, the Amazon sustains the world's richest diversity of birds, freshwater fish and butterflies. One of the world's last refuges for jaguars, harpy eagles and pink dolphins, its thousands of tree species are home to southern two-toed sloths, pygmy marmosets, saddleback and monkeys.

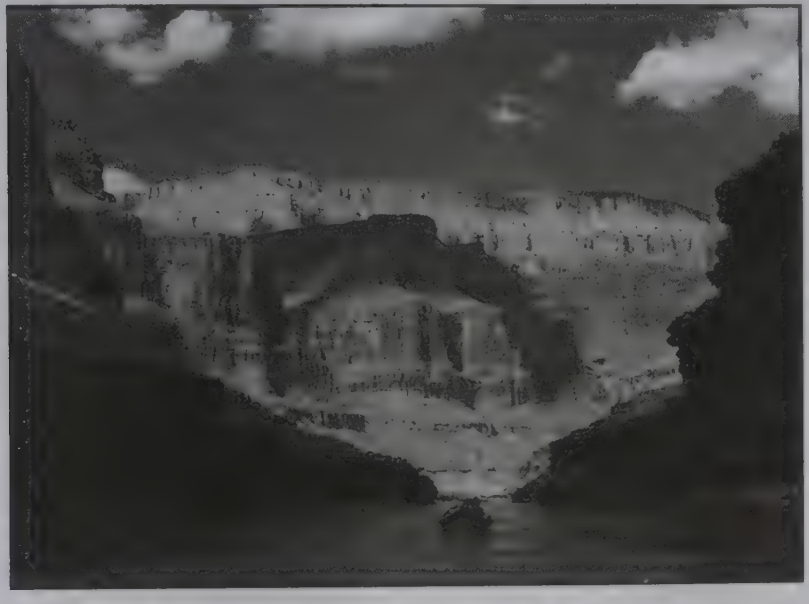
More than 350 indigenous and ethnic groups have lived in the Amazon for thousands of years, tapping nature for agriculture, clothing and traditional medicines. Today, more than 30 million people live in the region. Although most live in large urban centers, all residents remain dependent on the Amazon's ecosystem services for food, shelter and livelihoods. ❐

3

The Grand Canyon

Grand Canyon, immense gorge cut by the Colorado river into the high plateaus of north-western Arizona, U.S., noted for its fantastic shapes and colouration.

The broad, intricately sculptured chasm of the Grand Canyon contains between its outer walls a multitude of imposing peaks, buttes, canyons, and ravines. It ranges in width from about 0.2 to 29 kms and extends in a winding course from the mouth of the Paria River, near the northern



boundary of Arizona, to Grand Wash Cliffs, near the Nevada line, a distance of about 446 kms. The canyon includes many tributary side canyons and surrounding plateaus. The deepest and most impressively beautiful section, 90 kms long, is within Grand Canyon National Park, which encompasses the river's length from Lake Powell to Lake Mead. In its general colour, the canyon is a red, but each stratum or group of strata has a distinctive hue–buff and gray, delicate green and pink, and, in its depths, brown, slate-gray, and

violet. At 2,500m above sea level, the North Rim is 350m higher than the South Rim.

Grand Canyon National Park, now containing 4,931 square kms, was created in 1919. Its area was greatly enlarged in 1975 by the addition of the former Grand Canyon National Monument and Marble Canyon National Monument and by portions of Glen Canyon National Recreation Area, as well as other adjoining lands. The North and South rims are connected by a 346 kilometer long paved road and by a transcanyon trail. Scenic drives and trails lead to all important features. Mule-pack trips down the canyon and rides down the river in rafts and power-driven craft are intensively sought-after ways of viewing and experiencing the vast beauty of the canyon. Many pueblo and cliff-dweller ruins, with accompanying artefacts, indicate prehistoric occupation.

❐

4

Victoria Falls

Victoria Falls, spectacular waterfall located about midway along the course of the Zambezi River, at the border between Zambia to the north and Zimbabwe to the south. More than twice as wide and twice as deep as Niagara Falls, the falls span the entire breadth of the Zambezi River at one of its widest points (more than 1,700m). At the falls, the river plunges over a sheer precipice to a maximum drop of 108m. The falls' mean annual flow is almost 935 cubic meter per second.

The Zambezi River does not gather speed as it nears the drop, the approach being signalled only by the mighty roar and characteristic veil of mist for which the Kalolo-Lozi people named the falls Mosi-oa-tunya (The Smoke That Thunders). The lip of the falls' precipice is split into several parts by various small islands, depressions, and promontories along its edge. The eastern portions of the falls are mostly dry during times of low river flow.

The waters of Victoria Falls do not drop into an open

basin but rather into a chasm that varies in width from 25-75m. This chasm is formed by the precipice of the falls and by an opposite rock wall of equal height. The chasm's only outlet is a narrow channel cut in the barrier wall at a point about three-fifths of the way from the western end of the falls, and through this gorge, which is less than 65m wide and 120m long, flows the entire volume of the Zambezi river. At the gorge's end is the Boiling Pot, a deep pool into which the waters churn and foam at flood time. Just below the Boiling Pot, the gorge is spanned by the Falls Bridge, which carries rail, automobile, and pedestrian traffic between Zambia and Zimbabwe. The river's waters then emerge into an enormous zigzag trough that forms the beginning of Batoka Gorge, which has been cut by the river to a depth of 120-240m through a basalt plateau for a distance of 100 kms.

The British explorer David Livingstone was the first European to see the falls (on Nov. 16, 1855). He named them after Queen Victoria of the United Kingdom. In addition to the falls themselves, which now attract tourists from all parts of the world, adjacent Victoria Falls National Park (Zimbabwe) and Livingstone Game Park (Zambia) abound with large and small game and offer recreational facilities. ❐

5

The Harbour of Rio de Janeiro

At the beginning of the 16th century, the Portuguese explorers who sailed down Brazil's coast kept track of their discoveries, and the days of the year, by naming the former for the latter. On New Year's Day, 1502, they glided toward a narrow opening in the coastline, guarded by fabulously shaped mountains. Beyond this entrance lay a body of water stretching 20 miles inland. Convinced that they had reached the mouth of a great river, they named the area River of the First of January.

The large waterway was not a river; it was an island-studded bay that the Tamoio people had long before named Guanabara means 'arm of the sea.' Nearly five centuries later, both the native and European names persist. But now, instead of caravels and dugouts, supertankers and yachts glide across the magnificent balloon-shaped harbour of Guanabara Bay. No longer a tropical wilderness teeming with tapirs and jaguars, the bay's western shores now hold a roaring metropolis called Rio de Janeiro–the River of January.

The great bay that looked like a river was only one of many illusions that Rio held. Europeans called the smaller bay of Botafago, under Sugarloaf, a 'lake'; the Tamoio themselves named Guanabara Bay's eastern edge Niteroi, meaning 'hidden waters.' For early European voyagers, it was as though, when Rio hove into view, the curtain rose on a stage set with such strange, striking shapes and forms that virtually everything looked like something else.

Guarding the entrance to the bay, the naked and lopsided mountain the Portuguese called Pao de Acucar evoked the sugarloaves fashioned on the island of Madeira. They called the highest mountain Corcovado–'the hunchback'–for its humped profile. Today, a statue of Christ the Redeemer crowns the 2,300-foot-high peak.

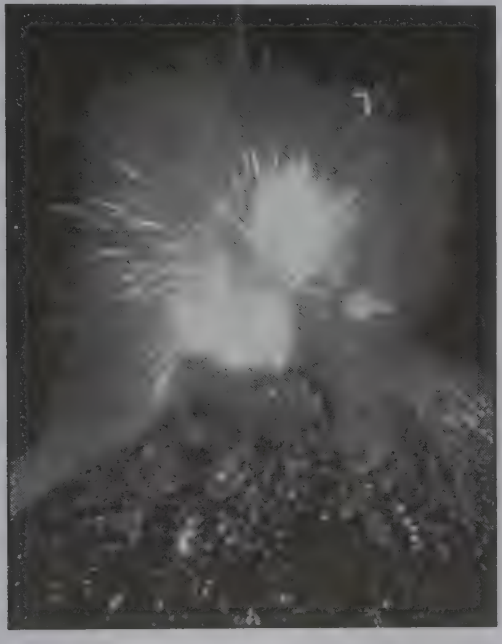
The bay's vastness has been shrinking. With usable land at a premium, landfill has twice altered Guanabara Bay's contours. In the 1920s and again in the 1960s, small hills that once had been home to Rio's earliest settlers were sluiced through pipes to create bayfill. The new land now anchors an airport, a six-lane highway, parkland and beaches, the city's modern art museum, and other 20th-century landmarks as Rio looks to its great bay for elbow room.

❐

6

Paricutin Volcano

On the afternoon of February 20, 1943, Dionisio Pulido, a farmer in the Mexican state of Michoacan, was readying his fields for spring sowing when the ground nearby opened in a fissure about 150 feet long. "I then felt a thunder," he recalled later, "the trees trembled, and then I saw how, in the hole, the ground swelled and raised it



self 2 or 2½ meters high, and a kind of smoke or fine dust–gray, like ashes–began to rise, with a hiss or whistle, loud and continuous; and there was a smell of sulphur. I then became greatly frightened and tried to help unyoke one of the ox teams."

Virtually under the farmer's feet, a volcano was being born. Pulido and the handful of other witnesses fled. By the next morning, when he returned, the cone had grown to a height of 30 feet and was "hurling out rocks with great violence." During the day, the cone grew another 120 feet.

That night, incandescent bombs blew more than 1,000 feet up into the darkness, and a slaglike mass of lava rolled over Pulido's cornfields.

The scientific world was almost as stunned as the hapless farmer himself by the volcano's sudden appearance. Around the world, volcanic eruptions are commonplace, but the birth of an entirely new volcano, marked by the arrival at the earth's surface of a distinct vent from the magma chamber, is genuinely rare. In North America, only two new volcanoes have appeared in historic times. One of them was western Mexico's Jorullo, born in 1759 some 50 miles south-east of Dionisio Pulido's property. The second, born about 183 years later in Pulido's field, was named Paricutin for a nearby village that it eventually destroyed.

Paricutin and Jorullo both rose in an area known for its volcanoes. Called the Mexican Volcanic Belt, the region stretches about 700 miles from east to west across southern Mexico. Geologists say that eruptive activity deposited a layer of volcanic rock some 6,000 feet thick, creating a high and fertile plateau. During summer months, the heights snag moisture-laden breezes from the Pacific Ocean; rich farmland, in turn, has made this belt the most populous region in Mexico.

Though the region already boasted three of the country's four largest cities–Mexico City, Puebla, and Guadalajara–the area around Paricutin, some 200 miles west of the capital, was still a peaceful backwater inhabited by Tarascan Indians in the early 1940s. Its gently rolling landscape, in a zone that had experienced almost no volcanic activity during historic times, was one of Mexico's loveliest. Although hundreds of extinct cinder cones rose around the small valleys, the only eruption in human memory had been that of distant Jorullo.

The Tarascan had no folk legends concerning volcanic eruptions in the area. But when Paricutin came into their lives, they saw events, in retrospect, that foretold the

cataclysm. The first event was a sacrilege: the 1941 destruction of a large wooden cross on a hillside. The second one hinted at biblical retribution: a plague of locusts in 1942. When 1943 began, so did the third sign: a series of earthquakes; these were preceded, said one man, by "many noises in the centre of the earth."

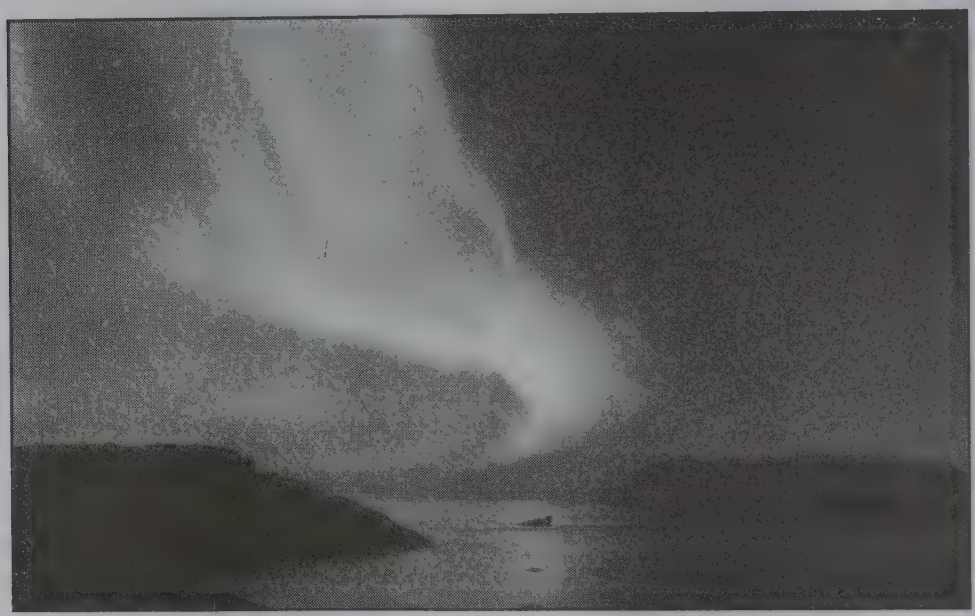
On February 19, the day before the volcano began to erupt, some 300 earthquakes shook the ground. On February 22, with the new cone rising and fiery skyrockets descending, the first of many geologists who would monitor and map Paricutin's behaviour over the next nine years arrived. From then on, Paricutin was under constant observation: It yielded a trove of information, including unique, fleeting glimpses of ephemeral features.

❐

7

The Northern Lights

Northern lights, or Aurora borealis brings together two mythological deities–Aurora, the Roman goddess of the dawn, and Boreas, Greek god of the north wind–to describe an event witnessed mostly at night in the high northerly latitudes. An identical phenomenon, the aurora australis, occurs in the high latitudes of the Southern Hemisphere, a region that has always been much more sparsely inhabited than the planet's northern reaches. Only a few eyewitness accounts of the aurora australis were available before 20th-century explorers arrived in Antarctica.



By contrast, the flowing ribbons, sky-filling swirls, otherworldly glow, gossamer veils, and brilliant rays of the aurora borealis are a regular presence that has awed and terrified northern peoples for thousands of years. To Finns the aurora was 'fox fire' sparked by glistening fur. Some Alaskan Inuit saw the dancing souls of deer, seals, salmon, and beluga; others believed that if they whistled the lights

might snatch them away. The Athabascan saw messages from their dead, the 'sky dwellers.'

For a long time, scientists offered almost as many interpretations of the northern lights as did the traditional peoples who observed them. The 20th century has brought with it studies of the earth's magnetism and the sun's workings. The aurora arises in the roiling turbulence of the sun. More than 100,000 times hotter than boiling water, the sun's interior chops the atoms that form solar gases into a thin stream of electrically charged particles–protons and electrons. Both matter and energy, this stream continuously erupts from the sun and is called the solar wind. Two or three days after bursting from the sun's surface at speeds of up to 500 miles a second, the solar wind reaches the earth, 93 million miles away.

The solar wind has the force to swiftly annihilate life on earth. What stops it from doing so is the shielding power of the planet's magnetic field, reaching out more than 40,000 miles into space. Like the earth, the sun is also a mighty magnet, and the solar wind carries fragments of its magnetic field. As solar particles crash into the planet's magnetic field, the fields repel each other.

Though most of the solar wind harmlessly sideswipes the magnetic shield, small streams of solar particles do manage to become trapped, spiraling down toward the planet's north and south magnetic poles. As they tumble, beams of electrons spread, ripple, and swirl, and yet their movements remain invisible. But when the solar wind hits the upper reaches of the ionosphere and encounters atmospheric gases, it starts churning the thin soup of oxygen and nitrogen there. Marvellous shapes and flowing patterns begin to appear. Electrons bouncing around among atoms of oxygen create a greenish glow much lower. Nitrogen molecules hit by solar wind may shine bright pink, or blue and violet, depending upon their distance from the surface.

The ever changing dance of lights belies the aurora's

permanence. Though only parts of it can be seen at any time, and almost never during the day, the aurora borealis forms a 2,000-mile-wide auroral oval above the magnetic north pole day in and day out, year after year.

What can dramatically change the oval are the occasional spikes in solar activity that turn the solar wind into a raging hurricane. Then, for a few days, the auroral oval flows toward the Equator and treats sky-gazers as far south as Mexico to midnight extravaganzas. At the same time, electromagnetic disturbances intensify, with overloaded power lines and scrambled communications serving to remind us of the force behind the celestial fireworks.

❐

The Seven Underwater Wonders of the World

A noted marine explorer named Jacques-Yves Cousteau wrote: "It is all strange, unearthly, and yet familiar. Strange because the sea, once it casts its spell, holds one in its net of wonders forever."

Diving is becoming a much more popular sport as humans become more fascinated with the diverse ecosystems of the deep. Coral reefs, like many of these underwater wonders, are structures built by living organisms. Second only to tropical rain forests in biodiversity, coral reefs provide homes for thousands of species. Unfortunately, they are at risk all around the world.

To promote awareness of the fragile marine ecosystem, CEDAM International–an organization dedicated to conservation, education, diving, and marine research - began the Seven Wonders of the World project in 1989. The message was simple: If underwater wonders are not protected, they will be lost forever. After considering sites around the world, CEDAM chose Palau, the Belize Barrier Reef, the Galapagos Islands, the Northern Red Sea, Lake Baikal, the Great Barrier Reef, and the Deep Sea Vents. Each was selected on the basis of its natural beauty, unique marine life, scientific research value, environmental significance, and whether it is representative of an overall area.

By focusing on these seven sites, CEDAM hopes to promote the protection of all underwater wonders. "We are the first generation to explore the wonders of the underwater world," says George Page, host of the public television series Nature. "Let's hope we are not the last."

1

Palau

Palau (Palauan *Belau*), republic, West Pacific Ocean, comprising more than 300 islands, islets, and atolls of the Caroline group. Major islands include Koror, the current seat of government, and Babelthuap, the future capital. Area of the republic, 487 sq kms. of the total population (1990, 15,122), ethnic Palauans make up about 83%; minority groups include Filipinos and Chinese. Palauan and English are the official languages. Leading occupations include fishing and subsistence agriculture; the country relies heavily on aid from the U.S. The U.S. dollar is the legal currency. Palau has a presidential system with a bicameral legislature.

Spain formally claimed the Palau Islands in 1885 but sold them to Germany 14 years later. Japan seized them in 1914 and established a naval base. The islands were captured by American forces in 1944, during World War II. After the war they became part of the Trust Territory of the Pacific Islands, administered by the U.S. under UN supervision. In 1980 the

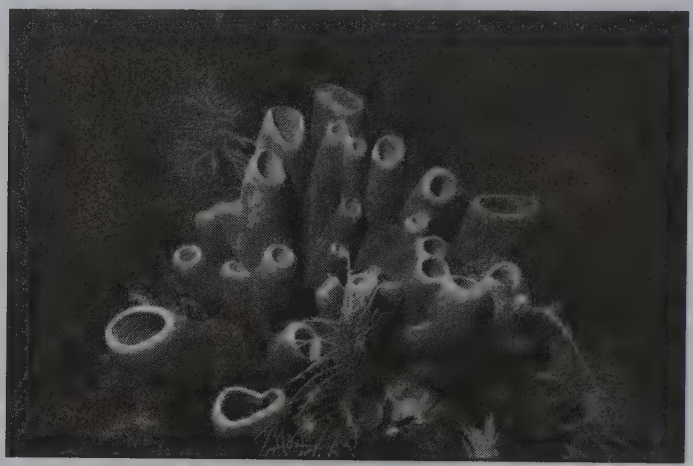
islands adopted a republican constitution. During the next ten years, a compact of free association granting Palau independence, but with defense remaining the responsibility of the U.S., was repeatedly submitted to referendum. The measure was supported by a majority of Palauan voters, but not by the 75 percent required to overcome a constitutional ban on port calls by U.S. nuclear-armed vessels. After a constitutional amendment eased this requirement, the compact passed in 1993. Palau became independent on Oct. 1, 1994, and was admitted to the UN in December.

❐

2

The Belize Barrier Reef

The second largest barrier reef in the world rises from the seafloor off the coast of Belize. A diver's paradise, it is known for fascinating coral formations, myriad fish and invertebrates, and exceptional water clarity.



On the ocean side of this 160-mile-long reef is a popular tourist designation known as Lighthouse Reef. Here, crystal-clear waters fill the famous Blue Hole, a crater more than 1,000 feet across and just over 400 feet deep. At the surface, healthy coral formations rim this wonder within a wonder, but at a depth of 125 feet, neither corals nor fish can be found. Instead, a diver finds stalactites formed during the Ice Age, when the world sea level was much lower and the Blue Hole was a subterranean cavern. The hole formed when the cavern's roof collapsed.

To the south is Glover's Reef, surrounded by waters so clear that visibility even at night is quite good: The long shaft of a diver's torch can pierce the water to a distance of 15 feet. Because it is several miles from the mainland, this reef is not affected by silt and sediment runoff. At Glover's, the arrival of a diver startles bright red cardinalfish swimming in open

water, they rely on organs called lateral lines running along both sides of their bodies. A combination of sonar and radar, a lateral line senses vibrations and movements in the water, allowing fish to detect predators and pray. It's also an early warning device. As a fish swims, it creates a sort of bow wake that bounces off solid objects. When another fish feels the wake, it moves to avoid a collision.

Glover's Reef is home to the Emerald Forest, a site named for magnificent elk horn coral 'trees' having trunks a foot diameter and canopies more than ten feet high. Several kinds of exotic fish also live here, and at night, a camera-bearing diver can catch them asleep, tucked in against the reef, but still out in the open. Butterflyfish as colourful as backyard butterflies hover in the water. So do hogfish with pig like snouts, trumpetfish that look like two-foot-long musical instruments, and parrotfish, their beak-like mouths closed for the night.

Not all of the reef's creatures are lost in sleep, however. Manta rays and sharks prowl the darkness, seeking meals. Lobsters, crabs, shrimp, and nudibranchs (the beautiful slugs of the sea) search the reef for food and mates. A Nassau grouper gets its mouth 'cleaned' by a tiny shrimp, which darts from side to side and from top to bottom to remove small parasites and dead flesh from the cooperative fish, its mouth frozen in a wide yawn. The shrimp gets a free meal, so to speak. Dr. Mary Wicksten, a marine biologist at Texas A&M University and a specialist in these so-called cleaning stations, says that fish seek out established stations on the reef because the activity is important for their health. Like several other reef fish, the Nassau grouper is remarkable for its ability to change sex as it gets older, increasing its chances for reproductive success when another grouper is met.

At a natural cut in Glover's Reef, where water surges during the changing of the tide, a diver can free-fall horizontally, whipped along by the strong current. But fish hover without obvious effort, their streamlined bodies

designed by nature to keep them in place in such conditions. Jutting from the walls of the cut, like fingers on a huge hand, are lavender tube sponges that eat by filtering tiny plants and animals from the sea. Soft coral sea fans, also filter feeders, bend in the breeze like underwater current that brings them a constant supply of food. The dominant life-form here is the hard coral, which is capable of withstanding the force of very strong wave action.

Where the current exits this canyon, it stirs up sand from the floor of a lagoon, reducing visibility. Somewhere near the bottom, turtles and manatees leisurely feed on sea grasses, while small coral heads form mini-reefs alive with tiny fish.

Across the lagoon is the Hol Chan Marine Reserve, a small area off Ambergris Cay where the tangled roots of a mangrove forest reach into the water. Even here, small fish dart among the roots, looking for meals or protection from predators.

Hol Chan, which is Maya for 'the cut,' was established in 1987. It encompasses all three habitats of the barrier reef ecosystem: reef, lagoon, and mangroves. Although separate, each area depends on the others. Marine scientist Jacque Carter, who has long studied Belize's fish, writes, "The mangroves are a feeding and breeding ground for reef fishes; they also trap silt and sediment runoff before it reaches the reef. The lagoon is...a feeding ground for many reef fishes, and the sea grasses...trap reef-smothering particles (keeping them) from reaching the lagoon, mangroves and shore areas from destructive wave action. If one area is damaged, the others are also affected–which is why it is important to protect the entire system, and not just the beautiful coral reef."

❐

3

The Galapagos Islands

Galapagos Islands or Colon Archipelago, group of islands, Ecuador, in the Pacific Ocean, constituting a province of the country, about 965 kms off the West coast. The archipelago consists of six larger and numerous smaller islands lying on or near the equator. The principal islands are Isabela, San Cristobal, Fernandina, San Salvador, Santa Maria, and Santa Cruz. The total land area is 8010 sq kms.

The islands are volcanic in origin, with level shorelines and mountainous interiors culminating in high central craters, some of which rise more than 1520m above sea level. Several volcanoes are active. The islands are fringed with mangroves; farther inland, although still in coastal regions, where little rain falls, the vegetation consists chiefly of thorn trees, cactus, and mesquite. In the uplands, which are exposed to a heavy

mist, the flora is more luxuriant. The climate and the temperature of the waters surrounding the islands are modified by the cold Humboldt Current from the Antarctic.

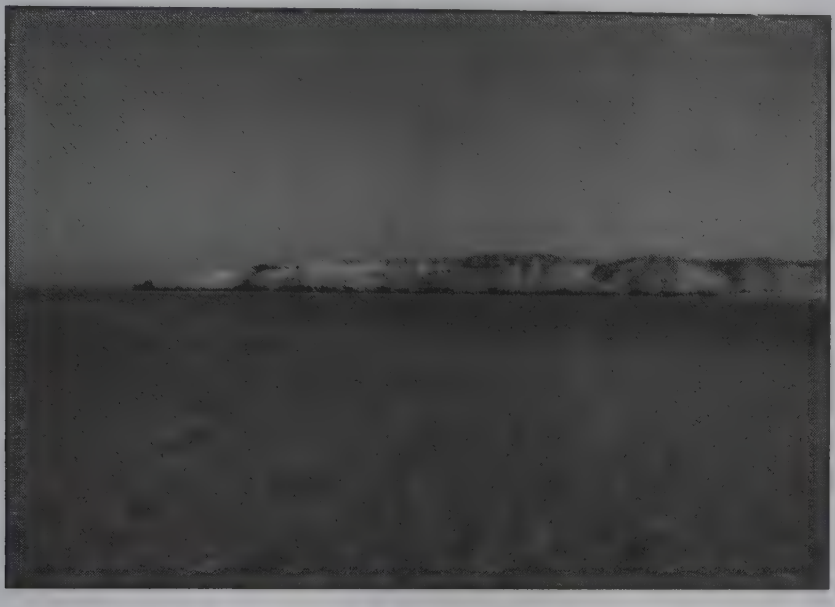
The Galapagos group is noted for its fauna, which includes numerous animals found only in the archipelago and different subspecies on separate islands. Unique to the archipelago are six species of giant tortoise. Other reptiles on the islands include two species of large lizards in the Iguana family: a burrowing land lizard and an unusual marine lizard that dives into the ocean for seaweed. The islands contain as many as 85 different species of birds, including flamingos, flightless cormorants, finches, and penguins. Sea lions are numerous, as are many different shore fish. Part of the Galapagos is a wildlife sanctuary.

❐

4

The Northern Red Sea

Red Sea, narrow, inland sea, separating the Arabian Peninsula, West Asia, from N.E. Africa. It extends N.W. from the strait of Bab al Mandab to Suez, Egypt, for a distance of about 2253kms. The maximum depth of the sea is about 2134m. The N extremity is divided by the Sinai Peninsula



into the gulfs of Suez and Aqaba. The Suez Canal connects the Red Sea with the Mediterranean Sea, and Bab al Mandab connects it with the Gulf of Aden, an arm of the Arabian Sea. The Red Sea occupies a portion of a zone of depression and faulting called the Great Rift Valley. For more than 50 million years, the earth's crust has been tearing apart all along this zone. The Red Sea formed when the Arabian Peninsula was torn from Africa, 20 million years ago. Hydrothermal vents on the seafloor are evidence of ongoing tectonic activity.

The site of the safe passage of the Israelites through the Red Sea is said to be the Gulf of Suez. In the centuries

following the downfall of the Roman Empire, the sea served the Muslim world as a major artery of communication and trade with eastern Africa, Persia (now Iran), and the Far East. To European nations, however, the sea was of minor commercial importance until the completion (1869) of the Suez Canal, making possible a comparatively direct sea route between Europe and the Far East. The principal Red Sea ports include Suez and al-Qusayr in Egypt, Port Sudan and Sawakin in Sudan, Massawa in Eritrea, Jeddah in Saudi Arabia, and al-Hudaydah and Mocha in Yemen.

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5

Lake Baykal

Lake Baykal in Siberian Russia is the third largest lake in Asia, and the largest freshwater lake of the Eurasian continent. Baykal has an area of 31,468 sq kms, and it has about 1963 kms of shoreline. The crescent-shaped lake is about 621kms long and varies in width from about 14 to 80 kms. With a maximum depth of 1741m, the lake is the deepest freshwater lake in the world and is estimated to contain approximately one-fifth of all the earth's fresh surface water.

The lake is fed by the Selenga, Barguzin, and Verkhnaya Angara rivers and by more than 300 mountain streams. The only outlet is the lower Angara, which flows from the lake into the Yenisey river. The Baykal, Barguzin, and other mountain ranges surround the lake, rising on all shores except the Selenga delta.

Lake Baykal has several islands, the largest of which is Olkhon. Nizhneangarsk and Listvyanka are ports on the lake. Baykal is known for the remarkable clarity of its waters

and for the great diversity of its plant and animal life; the majority of species found in the lake are endemic. The sturgeon, salmon, and freshwater-seal fisheries of the lake are valuable, and large quantities of other fish are also caught. Petroleum wells and mineral and hot springs are found in the vicinity. The south shores of the lake are inhabited by the Buryats.

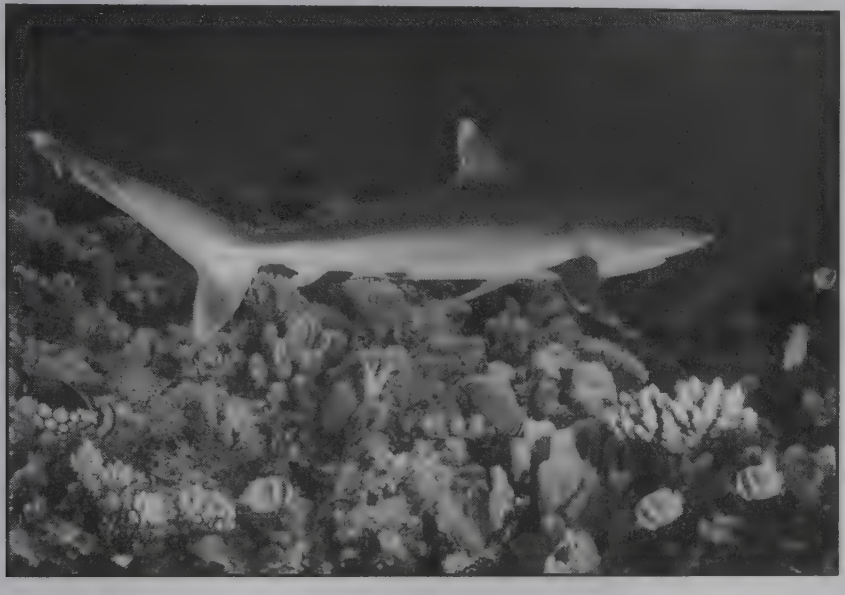
The discovery (1643) of Lake Baykal provided an important link in the trade route between Russia and China, connecting Listvyanka with points to the Mongolian frontier via the Selenga river. and tributaries. In the 1950s and '60s, much of the unique plant and animal life in Baykal was adversely affected when refuse from a Soviet pulp and papermaking complex on the south shore was deposited in the lake. During the 1970s efforts were made to curtail pollution and clean the lake's waters. A ban on fishing, imposed from 1969 to 1977, restored the stocks of many species.

❐

6

The Great Barrier Reef

Great Barrier Reef has look almost like a wall of perpendicular rock rising out of the sea–only it is not rock; it is coral. The Great Barrier Reef lies underwater and has snared many ships, including Captain Cook's in 1770. Though being one of the world's longest natural wonders, it unfortunately is also the most fragile around. It is a sweeping



2,000 kms in length, spanning along the northeast coast of Australia. It covers an area of 344,000 square kms and is made up of the skeletons of marine polyps that lived and died there, so it is generally lime-based. Sometimes the Great Barrier Reef is as close as 50 kms to the coast.

The Great Barrier Reef consists of more than 3000 reefs spanning from 1 hectare to 10,000 hectares in area and is mainly made up of coral. The reef, however, is not just about polyps–dead or alive–they are also large numbers of different forms of marine life. There are colourful and exotic fishes, countless shellfish and other fanciful creatures. It

abounds in wildlife. The variety of marine life ranges from nearly microscopic fishes to that of the larger fishes like the whale and the sharks.

There are more than 1500 species of fish, 4000 types of mollusk and, because of the abundance of fish, the reef is also home to more than 200 species of birds. The Great Barrier Reef houses anything and everything that thrives in shallow warm water.

It is also the only collection of organisms visible from Earth's orbit. It was declared a World Heritage in 1981. However, conditions like pollution, climatic change and various forms of human intrusion severely threaten its survival and continuance.

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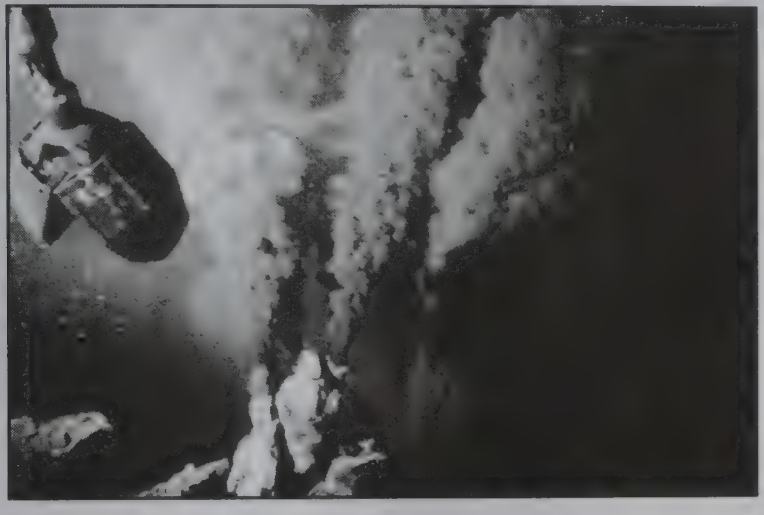
7

The Deep Sea Vents

Deep-sea vents are also known as deepwater seeps, deep-sea springs, hydro-thermal vents and blacksmokers. Found at ocean floor, they are formed by volcanic and tectonic activity in areas where huge hostile plates are unite or spread apart. Magma erupts along the margins of these plates, usually slowly, but sometimes with such ferocity that it creates instant lava lakes.



Black smokers were first discovered in 1977 around the Galapagos Islands by the National Oceanic and Atmospheric Administration by using a small submersible vehicle called Alvin which first took photographs of these vents. Today, black smokers are known to exist in the Atlantic and Pacific Oceans, at an average depth of 2100 meters.

Because no sunlight reaches the depths where the vents are found, these underwater wonders are visible only in the floodlights of a manned submersible. Pitch darkness, poison gas, heavy metals, extreme acidity, enormous pressure, frigid and searing water prevails at the deep seafloor which literally reminds us of hell.

Yet amazing communities of life exist at these vents and the inhabitants are perhaps the most fascinating of all the world's underwater wonders from a scientific perspective. Blind shrimp, giant white crabs, and a variety of tubeworms are just some of the more than 300 species of vent organisms that have been identified by biologists so far. The most striking fact is about the food chain that functions without sunlight. As it was believed earlier that only sunlight, through photosynthesis, could support life on Earth. But, at the vents, however, life begins with bacteria that metabolize hydrogen sulfide. The bacteria, in turn, become food for the other animals in the vent society.

One of the peculiar residents of these vents are the giant red-tipped tube worms-12-foot-tall creatures whose 300,000 tentacles strain food from the water. Equally fascinating residents include pink ventfish, sea cucumbers, sponges, and brittle stars, flowerlike animals that use their fine appendages to anchor themselves to rocks.

❐

The Seven Wonders of the Modern World

The 20th century has provided spectacular advances in design, engineering, and construction which have allowed humanity to create an array of monumental structures. And from these, the American Society of Civil Engineers (ASCE), with help from experts around the world, selected these wonders: the Empire State Building, the Itaipu Dam, the CN Tower, the Panama Canal, the Channel Tunnel, the North Sea Protection Works, and the Golden Gate Bridge.

These wonders embody an abundance of human ingenuity, thus showcasing humankind's ability to dream, plan, and achieve on a colossal, mind-boggling scale.

Man has an incredible ability to make the impossible, possible.

1

The Empire State Building

At 1,250 feet the Empire State Building is the best-known skyscraper in the world, and was by far the tallest building in the world for more than 40 years. The building's most astonishing feat however, was the speed in which it rose into the New York City skyline. Construction was completed in

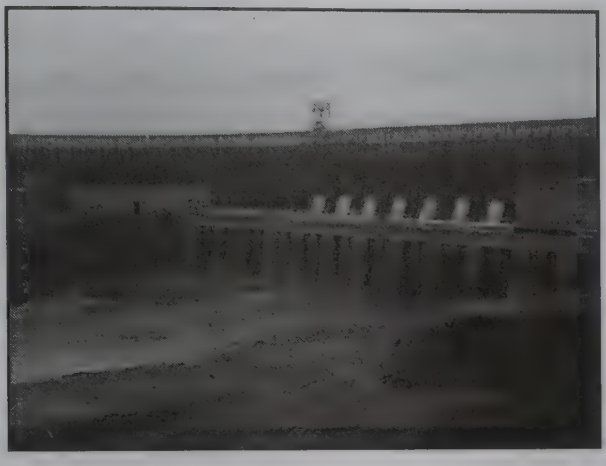
only one year and 45 days, without requiring overtime. Ironworkers set a torrid pace, riveting the 58,000-ton frame together in 23 weeks. While just below them, masons finished the exterior in eight months, and plumbers laid 51 miles of pipe and electricians installed 17 million ft. of telephone wire. The building was so well-engineered that is was easily repaired after a bomber crashed into it in 1945. The precise choreography of the operation revolutionized the tall building construction industry. Although it has been surpassed as the world's tallest building, the Empire State Building remains the standard against which all other skyscrapers have been judged for the last 65 years.

❐

2

The Itaipu Dam

The Itaipu hydroelectric power plant is the largest development of its kind in operation in the world. Built from 1975 to 1991, in a binational development on the Parana river, Itaipu represents the efforts and accomplishments of two neighbouring countries, Brazil and Paraguay. The power plant's 18 generating units add up to a total production capacity of 12,600 MW and a reliable output of 75 million MWh a year. Itaipu's energy production has broken several records over the recent years, after the last generating unit was commissioned in 1991. The generation of 77 million MWh a year in 1995 will again be surpassed in 1996, and the new record will be around the 80 million MWh a year mark.



The magnitude of the project can also be demonstrated by the fact that in 1995 Itaipu alone responded for 25% of the energy supply in Brazil and 78% in Paraguay. The power plant is also a major tourism attraction in the Foz do Iguacu area, having received around 9 million visitors from 162 countries. The Brazilian city of Foz do Iguacu, also home of the famous Iguacu Falls, is located at the Western tip of Parana State, right by the border with Paraguay and Argentina.

The Itaipu hydroelectric power plant, located 14 kilometers North of the International Bridge linking the

cities of Foz do Iguacu, Brazil, and Ciudad del Este, Paraguay, consists of a series of various types of dams a total distance of 7,744 meters with a crest elevation of 225 meters. The Powerhouse is located at the toe of the main Dam, most of it on the river bed and the rest on the Diversion Channel. The nominal power of the plant is 12,600 MW, divided between 18 generating units of 700 MW each, 15 of which are located in the main Powerhouse and the remaining three on the Diversion Channel. The Spillway is located on the right bank, and it has 14 segmented sluice-gates with a total discharge rate of 62,200 cubic meters per second (twice that of the highest flood-level on record). The Concrete Main Dam is of the hollow gravity type and is connected to the Spillway by a concrete buttress-type Wing Dam which continues thereon as a small Cardhfill dike. On the left bank a Rockfill Dam is linked to the Main Dam and at the other end to an Earthfill Dam. In order to build the main dam wall and the Powerhouse, the river was diverted through a Diversion Channel on the left bank.

The volumes of construction in Itaipu are also impressive. The volume of iron and steel utilized in the Dam structure would be enough to build 380 Eiffel Towers, and the volume of concrete used represents 15 times the volume utilized to build the Channel Tunnel between France and England. Itaipu is one of the Seven Wonders of the Modern World, according to a worldwide survey conducted by the American Society of civil Engineers (ASCE) and published in Dec. 1995 as a cover article of the North-American 'Popular Mechanics'. The article says that "To build the Dam, workers reenacted a labour of Hercules: they shifted the course of the seventh biggest river in the world (Parana river, at the Brazil/Paraguay border) and removed more than 50 million tons of earth and rock." According to the magazine, "The true marvel of Itaipu, though, is its powerhouse...a single building that puts out 12,600 megawatts–enough to power most of California".

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3

The CN Tower

It is fitting that television, the technological wonder that profoundly changed life in the 20th century, spurred the building of the era's tallest freestanding structure. In the late 1960's, Toronto's soaring skyline began to play havoc with signals from conventional transmission towers. Signals bouncing off the city's skyscrapers produced a number of problems, including the annoying phenomenon of 'ghosting'

on television sets. Weaker signals competed with stronger ones, giving viewers the effects of watching two programs at once. To improve the situation, Canadian National Railways, or CN, proposed building a transmission tower that would stand head and shoulders above Toronto's tallest buildings.

A Toronto firm prepared the initial design, enlisting the

aid of engineering experts the world over. Their original plan showed three towers linked by structural bridges. Gradually the design evolved into a single 1,815.5-feet-tall tower comprised of three hollow 'legs.'

Foundation work began in 1973. Giant backhoes excavated more than 62,000 tons of earth and shale to a depth of 50 feet from a along the shore of Lake Ontario in Toronto harbour. Next, prestressed concrete and reinforced steel were arranged in a Y-shaped pattern 22 feet thick. Each hollow leg of the Y would carry its fair share of the tower's 130,000-ton burden.

The foundation took only four months to complete. The tower itself presented a challenge of height never before met by the technique of poured concrete. To meet that challenge, engineers designed a huge mold known as a slip form. Concrete was poured 24 hours a day, five days a week, and as it hardened, the mold moved upward by means of a ring of hydraulic jacks. The ascending slip form gradually decreased in girth to give the tower its tapering shape.

When the tower reached the 1,100-feet mark, the builders made preparations for the SkyPod, a seven-story structure housing two observation decks, a revolving restaurant, a nightclub, and broadcasting equipment. The SkyPod is anchored by 12 steel-and-wooden brackets that were slowly pushed up the tower by 45 hydraulic jacks. Concrete formed the SkyPod's 'walls,' and a doughnut-shaped ring, called a radome, was added to its base to protect the delicate microwave dishes receiving radio and television transmissions. The SkyPod is reached by four high-speed, glass-fronted elevators whose rapid rise simulates a jetliner's takeoff, unless weather conditions call for a much slower ascent.

The concrete tower continues above the SkyPod, ending at the Space Deck 1,465 feet up. The Space Deck receives support from cantilevers extending out of the concrete section beneath it. After a 58-second elevator ride from the SkyPod

below, visitors can enjoy breathtaking vistas from a glass-enclosed balcony. On a clear day they might be able to glimpse sites 75 miles away.

For the last phase of construction, a Sikorsky Skycrane helicopter arrived to install the tower's 335-foot communications mast. One by one the helicopter lifted about 40 seven-ton sections of the mast to the top of the tower, where workers braved blustery March winds to receive them. When the sections were in place, they were secured by a total of 40,000 bolts. Afterward, the entire mast was covered by a fibreglass-reinforced sheathing to prevent icing.

Completed in 1975, the tower had cost $57 million to build, a bargain compared with other modern wonders. It also boasted incredible statistics of precision and safety. During construction, surveyors' transits up to a thousand feet away focused on optical plumbs mounted on the slip-form base.

Engineers established a wind-tolerance standard for the tower of 260 miles an hour, a level well above nature's most extreme demands. Counterweights on the antenna correct for wobble in high winds. Because the tower is an easy target for lightning, copper grounding wires were installed. As a result, visitors can safely view some 75 spectacular strikes a year.

The CN Tower is a work in progress. In recent years the tower gained two new elevators to accommodate an increase in visitors. To accomplish this, the 2,579-step metal staircase was moved to the interior of the structure. In addition, a glass floor was added to the SkyPod's observation deck. Brave visitors, the majority not surprisingly children, inch out over the visual void. More often than not the experience is pronounced, "Awesome!"

Almost twice as tall as the Eiffel Tower and more than three times the height of the Washington Monument, the CN Tower has taken proud ownership of Toronto's skyline, while exorcising the ghosts from its TV sets.

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4

The Panama Canal

Panama Canal, canal joining the Atlantic and Pacific oceans across the Isthmus of Panama. Running from Cristobal on Limon Bay, an arm of the Caribbean Sea, to Balboa, on the Gulf of Panama, the canal is slightly more than 64 kms long, not including the dredged approach channels at either end. The minimum depth is 12.5m, and the minimum width is 91.5m.

In 1980 the number of transits of the Panama Canal was 14,700, and the cargo transported was about 168,000 million metric tons. Transit time through the canal is seven to eight hours.

Interest in a short route from the Atlantic to the Pacific began with the explorers of Central America early in the 16th century. Hernan Cortes, the Spanish conqueror of Mexico, suggested a canal across the Isthmus of Tehuantepec; other explorers favoured routes through Nicaragua and Darien. The first project for a canal through the Isthmus of Panama was initiated by Holy Roman Emperor

Charles V, who in 1523 ordered a survey of the Isthmus. A working plan for a canal was drawn up as early as 1529, but was not submitted to the king. In 1534 a local Spanish official suggested a canal route close to that of the present canal. Later, several other canal plans were suggested, but no action was taken.

The Spanish government subsequently abandoned its interest in the canal, but in the early 19th century the books of the German scientist Alexander von Humboldt revived interest in the project, and in 1819 the Spanish government formally authorized the construction of a canal and the creation of a company to build it. Nothing came of this effort, however, and the revolt of the Spanish colonies soon took the control of possible canal sites out of Spanish hands. The republics of Central America subsequently tried to interest groups in the U.S. and Europe in building a canal, and it became a subject of perennial debate in the U.S. Congress. The discovery of gold in California in 1848 and the rush of would-be miners stimulated U.S. interest in digging the canal. Various surveys made between 1850 and 1875 indicated that only two routes were practical, the one across Panama and that across Nicaragua. In 1876 an international company was organized; two years later it obtained a concession from the Colombian government–Panama was then part of Colombia–to dig a canal across the Isthmus.

The international company failed, and in 1880 a French company was organized by Ferdinand Marie de Lesseps, the builder of the Suez Canal. His company went bankrupt in 1889. U.S. interest in an Atlantic-Pacific canal, however, continued. In 1899 the U.S. Congress created an Isthmian Canal Commission to examine the possibilities of a Central American canal and to recommend a route. The commission first decided on the Nicaraguan route, but reversed its decision in 1902 when the Lesseps company, reorganized, offered its assets to the U.S. at a price of $40 million. The U.S.

government negotiated with the Colombian government to obtain a strip of land 9.5 kms wide across the Isthmus, but the Colombian Senate refused to ratify this concession. In 1903, however, Panama revolted from Colombia. That same year the U.S. and the new state of Panama signed the Hay-Bunau-Varilla Treaty by which the U.S. guaranteed the independence of Panama and secured a perpetual lease on a 16-km strip for the canal. Panama was to be compensated by an initial payment of $10 million and an annuity of $250,000, beginning in 1913. The figure was later revised upward.

In 1905 the Isthmian Canal Commission decided to build a canal with locks rather than a sea-level channel, and this plan was approved by the U.S. Congress the following year. President Theodore Roosevelt put the construction work under the direction of the U.S. Army Corps of Engineers; Col. George W. Goethals was named to head the project.

The construction of the canal ranks as one of the greatest engineering works of all time. It was estimated that the canal would be completed in ten years; however, it was in operation by the summer of 1914. The construction involved not only excavating an estimated 143 million of earth, but also sanitizing the entire canal area, which was infested with the mosquitoes that spread yellow fever and malaria.

❐

5

The Channel Tunnel

The Channel Tunnel (popularly known as the Chunnel) is a complex of three tunnels under the English Channel, connecting Calais, France, with Folkestone, England. Constructed from 1987 to 1994, it is the first submarine link ever established between Great Britain and the European Continent. Previous tunnels were begun in 1883 and 1974,

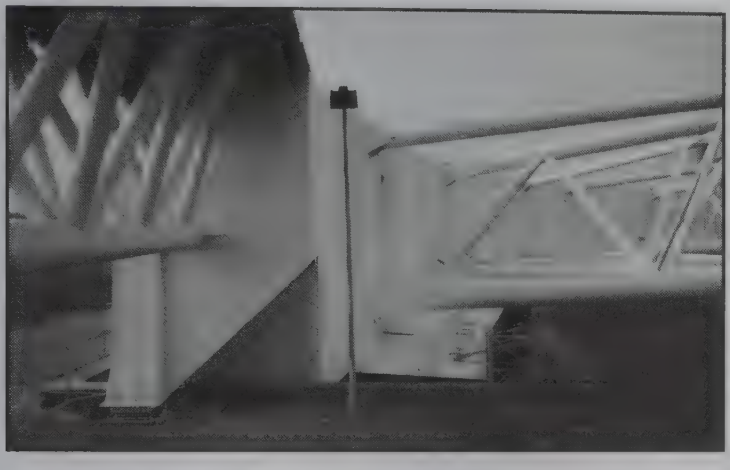
but were not completed. In 1986 the French and British governments awarded contracts for the present rail tunnel to an Anglo-French consortium known as CTG-FM (later rechristened Eurotunnel). Work began in December 1987, and the actual digging of the tunnels was finished in June 1991. The Channel Tunnel was finally inaugurated by Queen Elizabeth II and President Mitterrand of France in May 1994, one year later than had been projected. The construction delays and the total cost ($16 billion, more than twice the original estimate) nearly bankrupted Eurotunnel, which did not expect to break even until 1998.

The complex consists of two railroad tunnels, and between them a smaller service tunnel connected to the rail tunnels by cross-passages for maintenance and repairs. It is 50 kms long, 38 kms of which is under water. Eurotunnel's Eurostar passenger trains make the crossing in 35 minutes. Trucks and automobiles are loaded onto railroad cars and transported on Le Shuttle, the tunnel's rail freight service. ❐

6

The North Sea Protection Works (Netherlands)

Unique in the world, this vast and complex system of dams, floodgates, storm surge barriers and other engineered works literally allows the Netherlands to exist. For centuries, the people of the Netherlands have repeatedly attempted to push back the sea–only to watch merciless storm surges flood their efforts, since the nation sits below sea level and its land mass is still sinking.



The North Sea Protection Works consists of two monumental steps the Dutch took to win their struggle to hold back the sea. Step One–a 19-mile-long enclosure dam built between 1927 and 1932. The immense dike, 100 yards thick at the waterline, collars the neck of the estuary once known as the Zuiderzee. Step Two was the Delta Project to control the treacherous area where the mouths of the Meuse and Rhine Rivers break into a delta. The crowning touch was the Eastern Schelde Barrier, a two-mile barrier of tell gates slung between massive concrete piers. The gates fall only when storm-waters threaten. The North Sea Protection Works exemplifies humanity's ability to exist side-by-side with the forces of nature.

❐

7

The Golden Gate Bridge

The Golden Gate Bridge links San Francisco with Marin County in absolute splendour. The bridge is one of the architectural marvels of the 20 Century and a testament to human strife, as it was constructed during the years of the Great Depression. For years, the Golden Gate Bridge held the title as the longest suspension bridge in the world.

Before its completion in 1937, the bridge was considered impossible to build, due to persistently foggy weather, 60-mile-per-hour winds, and strong ocean currents, which whipped through a deep canyon below. In fact, the bridge is commonly known as the 'Bridge that couldn't be built.' Despite these unforgiving natural elements, the bridge was constructed in a little more than four years. The total cost was $35 million. The total length of the bridge spans 1.2 miles. Eleven men lost their lives during the construction of the bridge.

Even today, the massive spans of the bridge are often shrouded in fog. The bridge sways 27 feet to withstand winds of up to 100 miles per hour. International Orange was the colour chosen for the bridge because it blended well with the bridge's natural surroundings. The two great cables extending from the bridge contain 80,000 miles of steel wire, which is enough to circle the equator three times. The concrete poured to cement the bridge into the stormy waters below could have also been used to pave a five-foot sidewalk from New York to San Francisco.

Because of the Golden Gate Bridge, San Francisco is one of the premier skyline cities in the nation. It was a triumphant day in the history of the city when the bridge was completed on May 27, 1937. Over 200,000 people celebrated the grand opening of the Golden Gate Bridge by walking its length. The following day, a dedication ceremony was held to officially christen what would become the architectural trademark of the city. The regular flow of vehicular traffic began the next day.

Efforts to begin the construction on the bridge began as early as 1928. The process would entail the efforts of six counties in Northern California. In 1928, the counties formed a Golden Gate Bridge and Highway District. In 1930, the voters appropriated a $35 million bond issue to finance the building of the bridge.

For many years following, Joseph Baerman Strauss, a distinguished engineer, dreamed of raising a span across the Golden Gate. It was in response to his vision that people first started saying that the bridge could not be built. But, amazingly enough, Strauss held fast to his vision, and a span was eventually raised across the Golden Gate Bridge. The actual work on the bridge began on January 5, 1933. It was completed four-and-one-half years later. The result astounded the fiercest of Strauss's critics.

To this day, the bridge is admired for its magnitude and beauty. The bridge is nothing short of a powerful force

meant to combat nature. The often mighty winds from the Pacific Ocean are sustained by a mid span swing of 27 feet. The two towers of the bridge rise an impressive 746 feet, which is 191 feet taller than the Washington Monument. The pier of the bridge is only 1,215 feet from the shore, the distance between the two towers that support the cables, which in turn, support the floor of the bridge is 4,200 feet. These two cables are the largest bridge cables ever made at a little over 3.61 feet in diameter.

Today, pedestrians and bicyclists are still allowed to cross the bridge on pathways with breathtaking views of the city, Alcatraz, and the Marin Headlands. The bridge toll for vehicles is $5 when entering San Francisco.

The first exit of the Marin side of the bridge is Visa Point, which provides a magnificent view of the San Francisco skyline. But, the best way to view the bridge is to walk across. This usually takes about an hour.

❐

Seven Forgotten Natural Wonders of the World

The creations of nature have always remained a mystery to the mankind. It is really beyond the perception and comprehension of human mind how Supreme Nature has continued with its miraculous creations! Nature sometimes seems to be an invisible artist or painter who paints magnificent landscapes with one stroke of his brush; these landscapes are either vibrant with colours or are brown, grey and dark with rugged and ravaged features. Sometimes Nature seems to be at his peculiar fancy–playing the role of a creator or destroyer–inventing and devastating at his omnipotent will.

The list of seven forgotten natural wonders includes those majestic creations of nature which have inspired awe and admiration of human minds in the recent past.

1

Angel Falls

Angel Falls, Spanish Salto Angel, also called Salto Churun Meru, waterfall in the Guiana Highlands in Bolivar state, south-eastern Venezuela, on the Churun River, a tributary of the Caroni, 260 kms south-east of Ciudad Bolivar. The highest waterfall in the world, the cataract drops 979m and

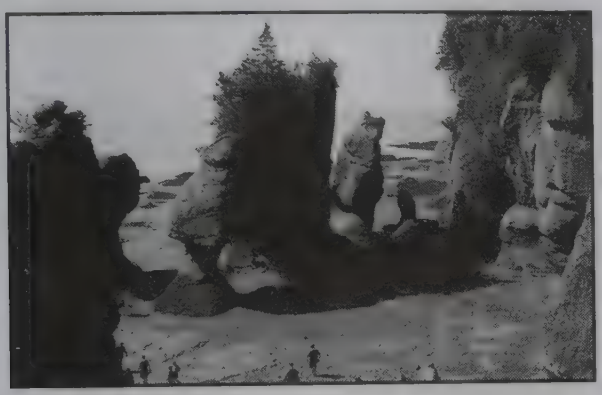
is 150m wide at the base. It leaps from a flat-topped plateau, Auyan-Tepui (Devils Mountain), barely making contact with the sheer face. The falls, discovered in 1935, were named after James Angel, an American adventurer who crash-landed his plane on a nearby mesa in 1937. Because of the dense jungle surrounding the falls they are best seen from the air.

❐

2

The Bay of Fundy

Bay of Fundy, large tidal inlet of the North Atlantic Ocean, separating the provinces of New Brunswick and Nova Scotia, and bordering on SE Maine. It is about 275 kms long and up to 80 kms wide. In the East, Fundy divides into two arms, Chignecto Bay on the North and Minas Channel (which leads into Minas Basin) on the South. The funnel



effect of these narrowing arms increases the tidal range of the bay, and at times the water in the arms rises by as much as 18m, creating one of the world's highest tides. The tidal surge in Chignecto Bay produces a large crested wave, or bore, ranging to 1.8m in height, in the lower Petitcodiac R. The rising tide in Fundy proper creates a 'reversing falls' on the lower Saint John river, at Saint John, N.B. Passamaquoddy Bay, a West arm of Fundy, forms part of the boundary between New Brunswick and Maine. Although Fundy is very deep, navigation is difficult because of the rapid rise and fall of the tide. Major deepwater harbours are located at St. John and at Digby and Hantsport, N.S. Fundy National Park borders the bay in New Brunswick. The bay was discovered by the French explorer Pierre du Guast, sieur de Monts, in 1604.

❐

3

Iguazu Falls

Iguazu Falls the fabulous array of waterfalls is located in Southern Brazil in the state of Parana on the border between Argentina and Brazil and are a UNESCO World Natural Heritage Site.

They encompass 2.5 miles plunging 269 feet into Iguazu River. Four times the width of Niagara Falls, Iguazu Falls are divided by various islands into separate waterfalls. One of the best known is Devil's Throat or Gargantua del Diablo with its continuous spray high over the falls. The Devil's Throat is a U-shaped island 150 meters wide and 700 meters long cliff, is the most impressive of all, and marks the border between Argentina and Brazil.

Ancient legend says that an angry local river god created the Iguazu gorge in his grave anger by dividing the river into falls when a tribes woman with whom he was in great love eloped with her mortal lover in a canoe through the river. But originally the Falls were the results of volcanic activity.

The vegetation of the region is rich and varied, ranging from semi deciduous to tropical. However various orchids are also found growing next to pines, bamboos, palm trees, and mosses, lianas and colourful begonias. Nocturnal wildlife species including jaguars and pumas inhabit the forests adjacent to the Iguazu Falls and other species are hidden in the dense rainforest growth.

❐

4

Krakatoa Island

Krakatoa is a volcanic island in the Sunda Strait between Java and Sumatra in Indonesia. It has erupted repetitively massively and with devastating consequences throughout recorded history. The best known eruption occurred in a chain of huge explosions on August 26-27, 1883. Several years of regional seismicity resulted in the famous caldera-forming eruption of August 1883.

The 1883 eruption threw away more than 25 cubic kilometers of rock, ash, and pumice and generated the loudest sound ever historically reported–the cataclysmic explosion was distinctly heard as far away as Perth in Australia. Near Krakatoa, according to estimated records, 165 villages and towns were ruined and 132 seriously damaged, at least 36,417 people died, and many thousands were injured by the eruption, mostly in the Tsunamis which followed the explosion. The eruption produced erratic weather and spectacular sunsets throughout the world for many months afterwards, as a result of sunlight reflected from suspended

dust particles ejected by the volcano high into Earth's atmosphere. It has been described as one of the deadliest eruptions of the world.

Recent eruptions of Krakatoa have been at Anak Krakatau, an island that emerged in 1927. One tourist was killed and five more injured by an explosion at Anak Krakatau in 1993. Anak Krakatau is undergoing relatively dormant periods, lasting at least a couple days, punctuated by periods of nearly continuous eruption. After having 44 years rest, the child of Krakatoa appeared in December 1927 and it is expanding until now. Now the child of Krakatoa has reached approximately 200m above sea level with the diameter of 2 kilometers.

The way to reach there is from Canti located in Kalianda. After about an hour's driving from Bandar Lampung, the boats take the tourists to the Krakatoa area.

Ancient Krakatoa was estimated 2,000 meters in height and radius of 9 kms.

Its great eruption happened in pre history in 416 as documented in the ancient Javanese book 'Pustaka Raja', and left 3 islands as the rest *i.e.* Rakata, Sertung and Panjang Island.

❐

5

Mount Fuji of Japan

Fuji or Fujiyama in Honshu Island, near Tokyo is the celebrated sacred volcano and highest mountain in Japan, rises as a cone to a height of 3776m above sea level, with the apex broken by a cone-shaped crater 610m in diameter. The south slopes extend to the shore of Suruga Bay, and the isolated peak can be seen from many of the outlying prefectures.

The mountain is part of Fuji-Hakone-Izu National Park. According to legend, Fuji arose from the plain during a single night in 286 BC. The most recent recorded eruption of Fuji lasted from Nov. 24, 1707, until Jan. 22, 1708. As the sacred mountain of Japan, it is visited annually by thousands of pilgrims from all parts of the country, and numerous shrines and temples are on its slopes. Fuji is also revered in Japanese literature and art.

❐

6

Mount Kilimanjaro

Kilimanjaro, mountain, Tanzania, the highest in Africa, near the border with Kenya. The two volcanic peaks of Kilimanjaro stand about 11 kms apart and are connected by a broad saddle; Kibo, the higher peak, rises to 5895m above

sea level; the summit of Mawensi is 5149m (16,892 ft) above sea level. The crater of Kibo is covered with an ice cap pierced by several small craters. Coffee and plantains are grown on the lower slopes of Kilimanjaro.

❐

7

Niagara Falls

It is a major tourist centre situated at the American Falls; the main attractions are included in New York State Niagara Reservation (1885). The city's manufactures include chemicals, machinery, forest products, and processed food; hydroelectric power also is produced. Niagara University (1856) is nearby.

The French built a fort on the site of the city in 1745. The British captured the region in 1759, and the U.S. settlement of Manchester was founded here in 1806. Held by the British

during the War of 1812, the community in 1848 was renamed Niagara Falls, Niagara being an Indian word for "at the neck." The first large hydroelectric facilities here were built in the 1890s. In the late 1970s and early '80s, as a result of chemical wastes having been dumped (1947–52) in the area of the Love Canal, the area was evacuated. In 1990, after a 12-year cleanup effort, the federal government declared parts of the area habitable and, despite the serious reservations of environmentalists, reopened those areas and sold homes there.

❐

The Seven Forgotten Modern Wonders of the World

The Seven forgotten modern wonders of the world account for the brilliance of the human mind, its perceptive power and adroit endeavours, which were considered as some of the greatest wonders of the world, but not great enough to leave behind an indelible impression on humanity's mind, and lost to the other greater and stupendous works of the human imagination. The momentous works of art and architecture by the humans and their ability to capture in realistic frame baffled travellers and onlookers from times immemorial and with the advance of the science and technology, engineering skills and construction facilities, the human hands began to carve out of their minds, edifices which made the world pleasanter and beautiful. The Seven forgotten modern wonders of the world is part of such grand endeavours, and although somewhere lost from the minds of humans, are unique and intriguing in their own special ways.

1

The Clock Tower (Big Ben)

Houses of Parliament, also New Palace of Westminster, seat of the British legislature, a great mass of buildings on the east bank of the Thames River in London, built (1840–60) after plans by Sir Charles Barry, on the site of the medieval royal residence, the Palace of Westminster, which was largely destroyed by fire in 1834. The buildings cover an area of more than 8 acres and contain 1100 apartments, 100 staircases, and 11 courts. The exterior, in rich late Gothic style, is impressive with its three massive towers: Victoria Tower (102m/336ft), Middle Tower (91m/300ft), and Saint Stephen's, or the Clock Tower (98m/320ft). The latter contains a clock with four dials, each 7m (23ft) in diameter, and a great bell, Big Ben, weighing 13.5 tons. Among the houses are the sumptuous House of Peers; House of Commons; Saint Stephen's Hall on the site of Saint Stephen's Chapel; the residence of the Speaker; the libraries, committee rooms, and lobbies connected with the House of Commons and the House of Peers; and offices. Westminster Hall (begun 1097) is all that remains of the original palace.

In World War II the buildings were seriously damaged during air raids. In 1974 a bomb planted by Irish nationalists slightly damaged Westminster Hall and destroyed an annex to it.

❐

2

The Eiffel Tower

Eiffel Tower, cast-iron tower in Paris, a landmark and an early example of cast-iron construction on a gigantic scale. It was designed and built by the French civil engineer Alexandre Gustave Eiffel (1832–1923) for the Paris World's Fair of 1889. The tower, without its modern broadcasting antennae, is 300m high. The lower section consists of four immense

arched legs set on masonry piers. The legs curve inward until they unite in a single tapered tower. Platforms, each with an observation deck, are at three levels; on the first is also a restaurant. The tower, constructed of about 6300 metric tons of iron, has stairs and elevators. A meteorological station, a radio communications station, and a television transmission antenna, as well as a suite of rooms that were used by Eiffel, are located near the top of the tower.

3

The Gateway Arch

Located on the banks of the Mississippi river in St. Louis, Missouri, United States, the 630-foot tall stainless steel, the Gateway Arch rises above the city skyline. It is a part of the Jefferson National Expansion Memorial which also contains the Museum of Westward Expansion, and the St. Louis' Old Courthouse. It is based on architect Eero Saarinen's design, who was the winner of the competition held a nation wide in 1947-1948.

The construction of the arch began on February 12, 1963, was finished on October 28, 1965 and was opened to the public on July 24, 1967. It cost about $ 13 million to build. The two bases are equilateral triangles with sides 54 feet long. At the top of the arch, the triangle is only 17 feet long on each side. Visitors enter the arch from an underground visitor's centre and can travel to the observation deck at the top in a 40-passenger tram that runs inside the arch.

The St. Louis Gateway Arch, standing at a height of 630 feet, is in the form of an inverted catenary, which is a very

stable structure that is often used in bridges, domes, and arches. A catenary is the shape that a chain or necklace forms when held by the two ends. The Dutch mathematician Christiaan Huygens named this curve from the Latin word catenarius, which means 'related to a chain'.

The arch has 60-feet deep foundations and weighs 43,000 tons. The arch is very stable and was built to withstand high winds and earthquakes (the Gateway Arch sways about one inch in a 20 mph wind and is designed to sway up to 18 inches in 150 mile per hour winds). Its exterior is composed of stainless steel. Trams, designed by Dick Bowser, are used to travel through the triangular shafts.

The first attempts in designing an appropriate system were based on several schemes, beginning with elevators. To get 3,500 people to the top of the Arch, which is the equivalent of a 63-story building, during an 8 hour day would require more than an ordinary elevator. Because of the triangular shape and the different slopes in the Arch, a standard elevator could only go up about 300 feet. Above that level, a small elevator at a steeper angle would be required. Standard elevators were therefore determined to be impractical.

The next solutions to be considered were escalators, the Ferris wheel and many others, but, there remained several inconsistencies in all of them. Finally, Dick Bowser put forward his proposal for the tramway, which made travelling through the Gateway Arch both convenient and possible. However, the interior of the Arch also contains two emergency stairwells in the event of a need to evacuate the Gateway Arch or if a problem develops with the tram system.

❐

4

The Aswan High Dam

Aswan High Dam, dam across the Nile River, Egypt, near the city of Aswan. Construction on the mammoth dam began in 1960, and the total cost was estimated at more than $1 billion. One-third of the cost was underwritten by the USSR, and 400 Soviet technicians were employed. By mid-1968 construction was completed. The last of the 12 Soviet-

built turbines was installed in 1970. The High Dam has an embankment 111m high that extends almost 1000m across the river. It impounds one of the largest reservoirs in the world. Called Lake Nasser in honour of the Egyptian president Gamal Abdel Nasser, this artificial lake covers an area more than 480kms long and 16kms wide. The project has a generating capacity of 2100 megawatts of electricity. The formation of Lake Nasser inundated many villages along the Nile.

The Aswan High Dam is about 6kms upstream from the Aswan Dam, which was completed in 1902. Hydroelectric installations were added in 1960 to the Aswan Dam.

❐

5

The Hoover Dam

Hoover Dam, structure at the border of Nevada and Arizona, situated at Black Canyon on the Colorado river, near Las Vegas, Nevada. A major engineering achievement, the massive dam is 221m high and 379m long at the crest.

The reservoir formed behind the dam is Lake Mead. Construction began in 1931 as part of the Boulder Canyon project and was completed in 1936. Originally named after President Herbert Hoover, the dam was later called Boulder Dam, but in 1947 its initial name was restored.

❐

6

Mount Rushmore National Memorial

Mount Rushmore National Memorial, South Dakota, established 1925. The central feature of the memorial is a group of colossal busts of Presidents George Washington, Thomas Jefferson, Abraham Lincoln, and Theodore

Roosevelt, carved in the granite face of Mt. Rushmore (1707m). The massive portraits, varying between 15 and 21m high, were carved from 1927 to 1941 under the direction of the American sculptor Gutzon Borglum. Area, 5.2 sq kms. ❐

7

The Petronas Towers

The Petronas Twin Towers in Kuala Lumpur, Malaysia, were the world's tallest towers from 1998 to 2004, if measured from the level of the main entrance to the structural top. Critics point out that this applies to only one of four height categories defined by the Council on Tall Buildings and Urban Habitat–although the three additional height

categories were only introduced as the tower neared completion in 1996, as opposed to the original category which had been in use since 1969.

The Petronas Towers were the tallest buildings in the world until the Taipei 101 building, as measured to the top of their structural components. Spires are considered integral parts of the architectural design of buildings, to which changes would substantially change the appearance and design of the building, whereas antennas may be added or removed without such consequences. The Petronas Towers remain the tallest twin buildings in the world.

The Sears Tower and the World Trade Center towers were each constructed with 110 occupied floors–22 more than the Petronas Towers' 88 floors. The Sears Tower and the World Trade Center's roofs and highest occupied floors substantially exceed the height of the roof and highest floors of the Petronas Towers. The Sears Tower's tallest antenna is about 76 meter taller than the Petronas Towers' spires. But the antennas of the Sears Tower were not counted as part of its architectural features. Hence, surpassing the roof of the Sears Tower by 10m.

These towers, which were designed by Cesar Pelli, an Argentine-American architect, were completed in 1998 and became the tallest buildings in the world on the date of completion. The 88-floor towers are constructed largely of reinforced concrete, with a steel and glass facade designed to resemble motifs found in Islamic art, a reflection of Malaysia's Muslim religion. They were built on the site of Kuala Lumpur's race track. Because of the depth of the bedrock, the buildings were built on the world's deepest foundations. The 120-meter foundations were built by Bachy Soletanche, and required massive amounts of concrete.

The Structural Engineer for the Petronas Towers was Thornton Tomasetti and Ranhill Bersekutu of Malaysia.

In an unusual move, a different construction company was hired for each of the towers, and they were made to compete against each other. Eventually the builders of Tower 2, Samsung Constructions (the Construction Division of Samsung Corporation), Kukdong Engineering &

Construction (both of South Korea), won the race, despite starting a month behind Tower 1, built by Hazama Corporation, although Tower 2 ran into problems when they discovered the structure was 25 millimeters off from vertical.

Due to a lack of steel and the huge cost of importing steel, the towers were constructed on a cheaper radical design of super high strength reinforced concrete. High-strength concrete is a material familiar to Asian contractors and twice as effective as steel in sway reduction; however, it makes the building twice as heavy on its foundation than a comparable steel building. Supported by 23x23 meter concrete cores and an outer ring of widely-spaced super columns, the towers use a sophisticated structural system that accommodates its slender profile and provides from 1300 to 2000 square meters of column-free office space per floor.

❐

Seven Forgotten Wonders of the Medieval Mind

Out of sight is out of mind – perhaps this has been the fate of the Seven forgotten medieval wonders of the world, which in the past had indeed inspired awe, admiration and respect in the heart of onlookers down the centuries after its creation but lost their importance to test of time. While some of these Seven forgotten medieval wonders of the world got eroded and destroyed to be converted to the state of ruins, some others lost in the competition with the more excellent works of human creativity and engineering feats that followed.

Medieval era around the world sparked the flame of intelligence and zeal for creativity, evident in the wondrous works of the time. But the turn of events and science since the time of the medieval to the modern world has been dramatic, leading to more extraordinary works, dwarfing the marvels of the medieval world.

1

Abu Simbel Temple

Abu Simbel, site of two temples, Egypt, on the Nile River, south of Aswan. The temples were carved into a sandstone cliff about 1250 B.C. during the reign of Ramses II. The interior of the larger temple is more than 55m in depth and consists of a series of halls and chambers leading to a central sanctuary.

This temple was dedicated by Ramses II to the chief gods of Heliopolis, Memphis, and Thebes. It is oriented so

that the rays of the rising sun illuminate the statues of the three gods and of Ramses II in the innermost sanctuary. The smaller temple was dedicated by Ramses to his queen, Nefertari, and to the goddess Hathor.

The facade of the larger temple has four sitting statues of Ramses II, each about 20m in height. Smaller statues of Ramses II, Nefertari, and their children adorn the facade of Nefertari's temple. The larger temple has numerous

inscriptions and reliefs, some of them of unusual historical interest. A series of reliefs depicts the battle between the Egyptians and the Hittites at Kadesh. Two of the large sitting statues of Ramses have inscriptions in Greek dating from the 6th century BC. They were written by Greek mercenary soldiers and are among the earliest dated Greek inscriptions.

The temples, the most important monuments of ancient Nubia, were unknown to the West until 1812, when they were discovered by the Swiss explorer Johann Ludwig Burckhardt (1784–1817). In 1964 an international project was begun to save the temples from inundation by Lake Nasser, the reservoir of the Aswan High Dam. The temples were cut apart and, in 1968, reassembled on a site 64m above the river.

❐

2

Angkor Wat

Angkor, capital city of Cambodia from the 9th to the 15th century. Its ruins are one of the world's great architectural monuments. Located near Siemreab in north-western Cambodia, Angkor was founded early in the 9th century and became the country's capital under King Yasovarman I (889–900), who called it Yasodharapura.

The original city was built around the Phnom Bakeng, a temple on a hill symbolizing the mountain that stands in the centre of the world according to Hindu cosmology. Successive kings enlarged the city, building other temples devoted to various Hindu deities and large reservoirs used for irrigation, which also symbolized the ocean surrounding the holy central mountain.

The greatest of the Angkor temple complexes is Angkor Wat, constructed under King Suryavarman II (1113–50) to celebrate the king as the incarnation of the god Vishnu. An immense rectangle, measuring about 850 by 1000m, Angkor Wat contains concentric walled courtyards surrounding a

central structure with five graceful lotus-shaped towers. Its galleries are decorated with sculptures depicting legends of Vishnu. King Jayavarman VII (1130–1219) built the Angkor Thom complex, which contains the Bayon, a Buddhist temple embellished with huge stone heads of the king.

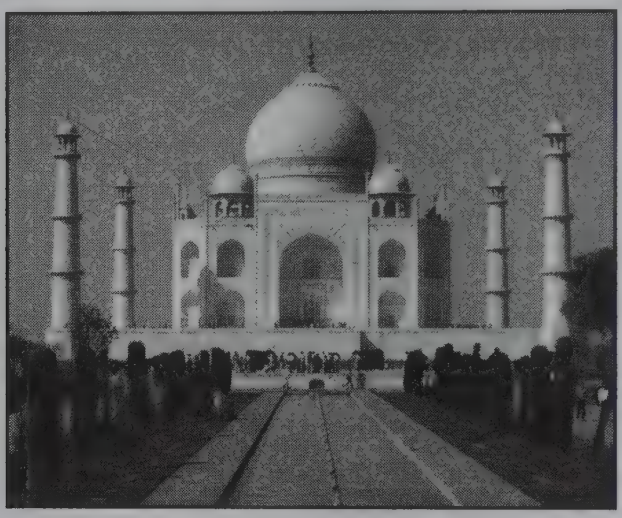
In the 13th century Angkor covered about 100 sq kms and was one of the largest cities in the world. Shortly thereafter, it began to decline. Threatened by attacks from the neighbouring Thais, the Cambodians left Angkor about 1430, moving their capital south for greater security. Angkor Wat survived for a time as a Buddhist pilgrimage centre, but the rest of the city was covered by the jungle until French archaeologists began to excavate it in the 1860s. A six-to-eight-year restoration project was begun in 1987.

❐

3

Taj Mahal

Taj Mahal, mausoleum on the southern bank of the Yamuna River, outside Agra in India. It was built by the Mughal emperor Shah Jahan in memory of his wife, Arjumand Banu Begam, also called Mumtaz Mahal. She died in childbirth in the town of Burhanpur in 1631, after having been the emperor's inseparable companion since their marriage in 1612. The building was commenced around



1632 to plans prepared by a council of architects from India, Persia, Central Asia, and beyond. More than 20,000 workers were employed daily to complete the mausoleum itself by about 1643 and the immediate adjuncts (mosques, wall, and gateway) by about 1649. The entire Taj complex took 22 years to complete, at a cost of 40 million rupees.

The complex consists of a rectangular plot measuring 580 x 305m and aligned north and south. At the centre of this rectangle lies a square garden area, 305m on each side, that is bounded on the north and south by two smaller, oblong sections. The southern oblong section comprises a sandstone entrance gateway to the complex, along with

attendant service buildings, while the northern oblong section terminates at the Yamuna river's edge and comprises the famed mausoleum itself. The mausoleum is flanked on the west and east by two symmetrically identical buildings, the mosque and its jawab (building for aesthetic balance), respectively. A high boundary wall with octagonal pavilion turrets at the corners surrounds the northern section and the central garden area, while outside the enclosure at the south are stables and guard quarters.

The whole complex was conceived and planned as an entity because Mughal building practice allowed no subsequent addition or amendment. Its northern end contains the most significant architecture, with mosque and jawab both facing the mausoleum itself. The mosque and jawab of red Sikri sandstone, with marble-necked domes and architraves and some restrained hard stone surface decoration, contrast in colour and in texture with the mausoleum of pure white Makrana marble.

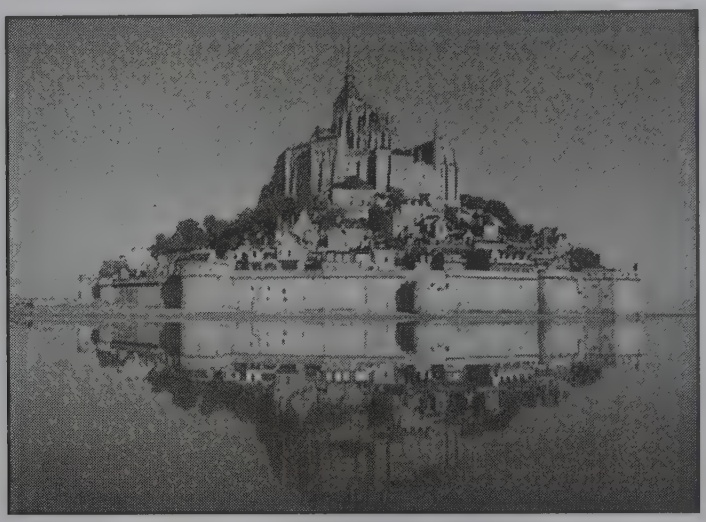
The mausoleum itself, which stands on a marble plinth 7m high, has four identical facades with chamfered corners and a massive arch that rises to a height of 33m on each face. A bulbous double dome supported on a tall drum completes the structure. The skyline rhythm of the mausoleum is created by parapets over each arch and by pinnacles and domed kiosks over each corner. A three-storied minaret stands at each corner of the plinth, its countersunk face joints of marble bricks contrasting with the highly finished marble of the mausoleum. The mausoleum interior is organized around an octagonal chamber, with low-relief patterns and fine hard stone, and contains the cenotaphs of Arjumand Banu Begam and Shah Jahan. These marble tombs are decorated with hard stone and enclosed by a perforated marble screen studded with precious stones. A vault below, at garden level, contains the true *sarcophagi.* The Taj Mahal is regarded both as a supreme achievement of Mughal architecture and as one of the most beautiful buildings in the world.

❐

4

Mont Saint Michel

Mont Saint Michel, rocky, cone-shaped islet, NW France, in the Gulf of Saint-Malo, connected by a causeway with the mainland. The islet, celebrated for its Benedictine abbey, has small houses and shops on its lowest level. Above these stand the monastic buildings, many of which date from the



13th century and are considered outstanding examples of Gothic architecture. The entire islet is crowned by the abbey church, about 73m above sea level. The abbey was founded in 708 by St. Aubert of Avranches (d. 725). The strongly fortified abbey resisted the assaults of the English during the Hundred Years' War; was used as a political prison during the French Revolution; and is now a French historical monument. Henry Adams wrote a notable study of Mont-St-Michel.

❐

5

The Moai Statues

Easter Island, Spanish Isla de Pascua, also called Rapa Nui, island in the eastern Pacific Ocean, 3,600 kms west of Chile. It is a province that is administratively part of Chile's Valparaiso region.

Easter Island is small and hilly, formed by a series of separate underwater volcanic eruptions, and has an area of 163 sq kms. The island is mostly covered with grassland. The

climate is subtropical, and farming is the traditional occupation. Its mixed population is predominantly of Polynesian ancestry; almost all live in the village of Hanga Roa on the sheltered western coast. Cattle are raised, and some sweet potatoes, sugarcane, figs, bananas, gourds, taro, corn, and potatoes are grown. Tourism, however, has become the mainstay of the economy. There is no natural harbour, but anchorages are found off the coasts of neighbouring islands. There are a commercial airport, with flights from Santiago, Chile, and several small hotels on the island, but horses and four-wheel-drive vehicles are needed for local transport because of a lack of paved roads.

Initially inhabited about AD 400 by Polynesians from the Marquesas, Easter Island has long been famous for the rongorongo hieroglyphs and remarkable monolithic stone statues in human form. They have evoked various legends and theories as to their origin. The statues, carved from tuff, a soft volcanic stone, range in height from 3 to 12m, some weighing more than 50 tons. The non-Polynesian vestiges on Easter Island have given rise to much speculation, but the most recent archaeological work indicates that most of the statues were erected in the Middle Period (AD 1000-1600) and that environmental degradation and fighting among the islanders (culminating in the Peruvian slave raids of 1862-63, in which about one-third of the population was carried off) brought precipitous decline to the island's fortunes. When a few of the abducted islanders were returned, they brought smallpox and tuberculosis, and the island suffered further severe depopulation and cultural decline. With the introduction of Christianity in the later 1860s, the surviving Polynesian traditions were forgotten.

The first European to see Easter Island was the Dutch admiral Jakob Roggeveen, in 1722. In 1888 the island was annexed by Chile, which leased nearly all its territory for sheep raising. Sheep ranching came to an end in the mid-1980s, and the island is now administered by a civilian governor. Chile has declared the entire island a historic monument.

❐

6

The Parthenon of Athens

The Parthenon, an octostyle, Doric temple with Ionic architectural features was a temple of Athena, built in the 5th century B.C. on the Acropolis of Athens. It was dedicated to Athena Parthenos, the patron goddess of Athens. Parthenon is the most distinguished and significant edifice of

Ancient Greece, and has been appreciated as the finest accomplishment of Greek architecture. Its decorative sculpture is considered one of the characteristic features of classical Greek art. Regarded as one of the world's greatest cultural monuments, the Parthenon is an enduring symbol of Ancient Greece and of Athenian democracy.

The name of the Parthenon is derived from the colossal statue of Athena Parthenos, sculpted in ivory and gold by Phidias and is placed in the eastern room of the building. This statue refers to the unmarried and virginal status of the Goddess, (parthenos meaning virgin).

The Parthenon was built by architects Iktinos and Kallikrates in the site an older temple of Athena that had been destroyed by the Persians in 480 B.C.

Made of Pentelic marble, it is peripteral, with eight columns on each of the narrow sides and seventeen columns on each of the extended sides. The central part of the temple, called the cella, encloses the famous chryselephantine cult statue of Athena. The sculptural decoration of the Parthenon is a unique combination of the Doric metopes and triglyphs on the entablature, and the Ionic fresco on the walls of the cella. The Procession of the Panathenaea, the most formal religious festival of ancient Athens is depicted by the relief wall painting.

In the 6th century AD the Parthenon was converted into a Byzantine church dedicated to the Virgin and after the Turkish conquest, it was transformed into a mosque. In 1687 AD, one of the Venetian bombs fell on the Parthenon and caused a tremendous explosion that damaged the Parthenon and its sculptures. The Parthenon, along with the other structures on the Acropolis, is now one of the most visited archaeological sites in Greece.

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The Shwedagon Pagoda

The most significant feature of Shwedagon Pagoda in Myanmar is consisting of eight genuine Sandaw (Hairs of Head) of the Lord Gawdama Buddha, which were kept, as treasures together with tremendous amount of precious stones and other jewellery inside the pagoda. All the more so, Shwedagon Pagoda was decorated with nine wonders.

Shwedagon Pagoda was believed to be built, way back to 2500 years ago. The King of Okkalapa was famously to be known in building up the whole task. It is situated right on top of the 'Thein Gottara Hill'.

Known as the highest hill in Yongon, the total amount of pure gold alone with Shwedagon can be expected as of today, nearly nine tonnes even. It was learnt that the last general renovation was done in the year 1871 during the era of King Mindon.

The perimeter of the base of the Pagoda is 426 m and its

height 98m above the platform. The base is surrounded by 64 small pagodas with four larger, one in the centre of each side. There are 4 entrances leading into the base of this great Shwedagon Pagoda. No one is sure what is inside. According to some legendary tales, there are flying and turning swards that never stop, which protect the pagoda from intruders; some says there are even underground funnels that leads to Bagan and Thailand.

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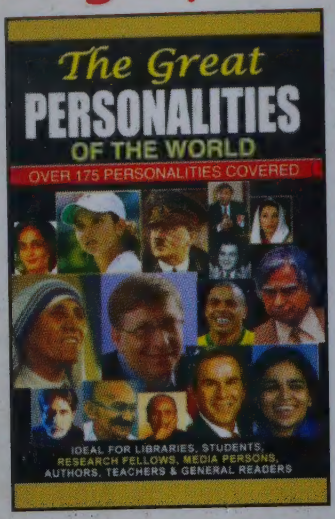
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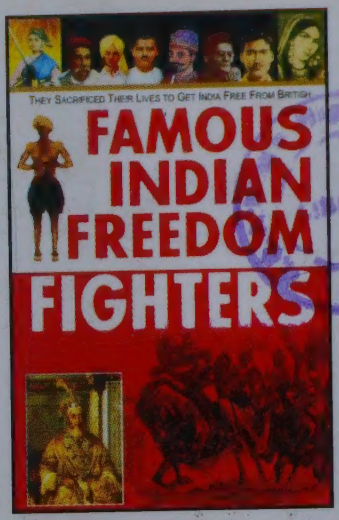

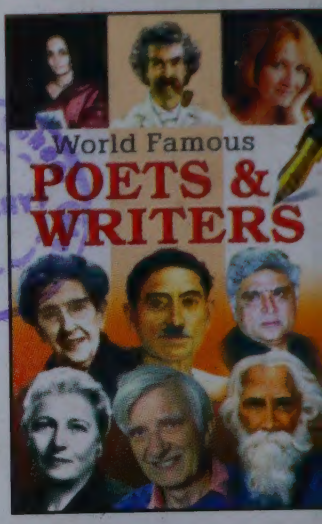

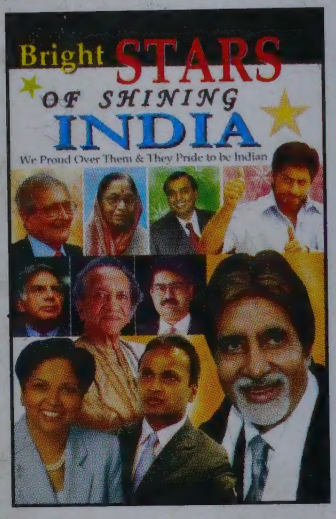

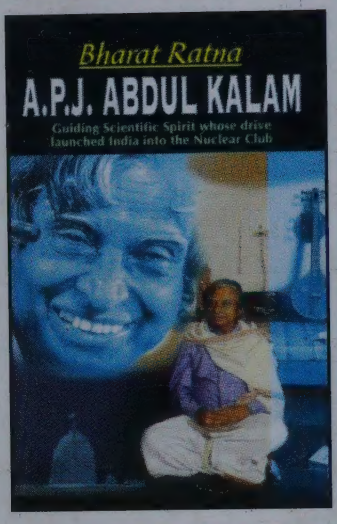

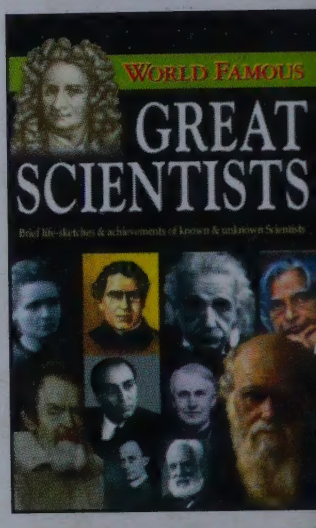

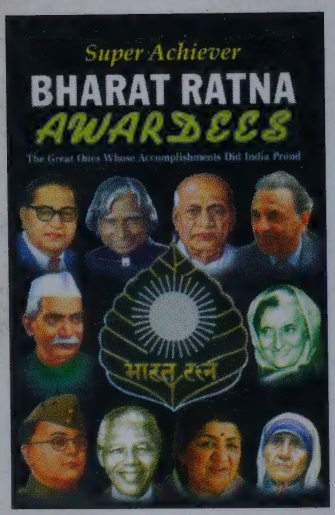

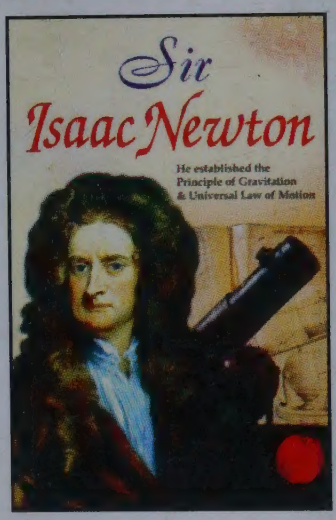

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